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OF THE

BROOKLYN ENTOMOLOGICAL SOCIETY

Vol. LVII 1962

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JOHN F. HANSON

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JOHN F. HANSON
GEORGE S. TULLOCH JAMES A. SLATER

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THE NORTH AMERICAN SPECIES OF THE BITING MIDGE GENUS *JENKINSHELEA* MACFIE (DIPTERA: CERATOPOGONIDAE)

By Willis W. Wirth[1]

For several years J. Antony Downes of the Entomology Research Institute in Ottawa has been studying intensively the morphological adaptations of the antennae of the Diptera Nematocera to their mating habits and to the feeding habits of the female sex (Downes, 1958, Ann. Rev. Ent. 3:249–266; 1958, Proc. Tenth Int. Congr. Ent. 2:425–434). A remarkable diversity has been found in antennae of male Ceratopogonidae and Dr. Downes has kindly called my attention to two forms of male antennae in the North American species, for many years called *Jenkinshelea albaria* (Coquillett). Upon his suggestion I have studied the male genitalia and other characters of the northern form with very short, male antennal plumes and compared them with those of the southern form with normal long, male antennal plumes. From these studies it is apparent that two species are involved, for which names are already available. The purpose of this paper is to present the characters by which these species may be separated, to give some new synonymy, and to outline the distribution of each species as currently known.

Key to the North American Species of *Jenkinshelea*

1. Female wing 3.6–4.2 mm. long; hairs of male antennal plumes pale and short, not more than three times as long as their segment; male scutum with sparse, short, erect black hairs; male parameres (Figs. 1, 2) with distal portion evenly ta-

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[1] Entomology Research Division, Agric. Res. Serv., U. S. D. A.

pered and gradually bent ventro-cephalad; male aedeagus (Fig. 3) about 1.5 times as long as broad, longitudinally wrinkled, without distinct, sclerotized, median peg-like sclerotization or distomedian sclerotized lobes, and distal margin finely serrated. . . . . . *magnipennis* (Johannsen)

Female wing 2.4–2.8 mm. long; hairs of male antennal plumes dark and long, about five times as long as their segment; male scutum without abundant, long, erect, black hair; male parameres (Fig. 4) with abruptly recurved distal portion flattened and broadened subapically, blade-like, more abruptly tapering to sharp distal point; aedeagus (Fig. 5) more than two times as long as broad, with median peg-like sclerotization on distal half, proximally transversely wrinkled, and with prominent, distolateral, smooth, sclerotized lobes. . . . . *albaria* (Coquillett)

Jenkinshelea albaria (Coquillett)
Figures 4–6

Ceratopogon albarius Coquillett (as *albaria*), 1895, Proc. Acad. Nat. Sci. Philadelphia 1895: 308 (female; Drayton Island, Fla.).

Johannsenomyia albaria, Malloch, 1915, Bul. Illinois St. Lab. Nat. Hist. 10 : 335 (Ill.; female; syn.: *magnipennis* (Johannsen).

Jenkinshelea albaria, Johannsen, 1942, Ent. News 53 : 76 (notes, fig. female wing, pupa). — Johannsen, 1943, Ann. Ent. Soc. Amer. 36 : 783 (e. U. S.).

Johannsenomyia aequalis, Malloch, 1915, Bul. Illinois St. Lab. Nat. Hist. 10 : 336 (male; Ill.). — Johannsen, 1943, Ann. Ent. Soc. Amer. 36 : 784 (N. Y.). NEW SYNONYMY.

The synonymy of *aequalis* is made as a result of the study of the type, loaned through the courtesy and cooperation of H. H. Ross of the Natural History Survey, Division of the State of Illinois. The exceptionally large hypopygium, unspined fifth tarsal segment, third vein to four-fifths the wing length, first vein distinctly short of middle of the third, are characteristic of *Jenkinshelea,* whereas the presence of long antennal plumes places the species as *albaria.* Common in Illinois, the male of this species was unknown as such to Malloch, who was misled by the sexual dimorphism of several species in his Illinois study. A male from Ithaca, New York, in the Cornell University collection and determined by Johannsen as *aequalis,* also proved upon examination to be *albaria.*

The parameres of two males from Kerrville, Texas, differ from the typical form of *albaria* (Fig. 4) in bearing blunt, knobbed apices as figured (Fig. 6); no other differences from the typical form were noted. Possibly a third species, whose female has not yet been recognized in the Texas material at hand, may be represented here.

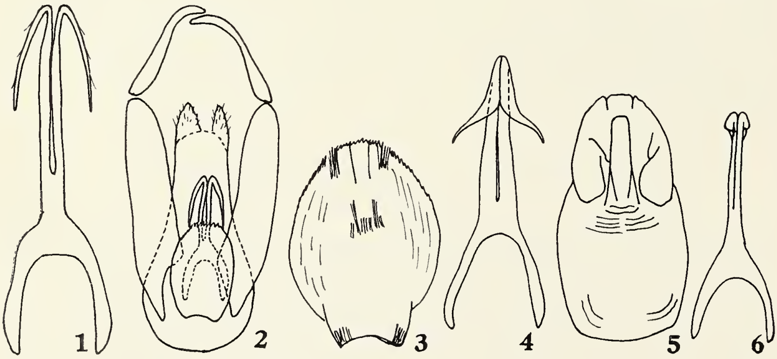
Specimens examined.—**Arkansas**: Little Rock, 13 July 1904 (H. S. Barber) at light, 1 ♀. **Florida**: Arcadia, 30 March 1954, K. V. Krombein, 1 ♀; Lake Alfred, Oct. 1952 (M. H. Muma) 2 ♀♀; Orlando, 27 May 1907, 2 ♀♀; Santa Rosa Co., 25 July 1955 (F. W. Mead) 1 ♀. **Illinois**: Monticello, Sangamon R., 21 June 1914 (J. R. Malloch) 1 ♀ (Ill. Nat. Hist. Surv. coll.); Muncie, Stony Creek, 5 July 1914 (J. R. Malloch) 1 ♂, 1 ♀ (type male of *J. aequalis* Mall., from Ill. Nat. Hist. Surv. coll.); Sumner, 2 Aug. 1914 (J. R. Malloch) 1 ♀ (Ill. Nat. Hist. Surv. coll.). **Louisiana**: Baton Rouge, 6 May 1947 (W. W. Wirth) at light, 1 ♀; Lake Providence, 14 July 1953 (W. W. Wirth) 1 ♂, 1 ♀. **Maryland**: Plummers Island, 24 Sept. 1902 (Barber and Schwarz) 16 ♀♀; 1 Aug. 1903 (A. Busck) 1 ♀; 8 June 1914 (Schwarz and Shannon) at light, 2 ♀♀ (male genitalia attached). **Mississippi**: Utica, Aug., 1 ♀. **New York**: Ithaca, June 1901, 1 ♂ (det. as *J. aequalis* Mall. by Johannsen; Cornell Univ. coll). **Texas**: Denison, 15 June 1938 (L. D. Christenson) 1 ♀; Devils River, 2 May 1907 (Bishopp and Pratt) 1 ♀; Dryden, Terrell Co., Apr., May 1954 (O. Schomberg) light trap, 1 ♀; Kerrville, May 1954, June–Aug. 1953 (L. J. Bottimer) light trap, 3 ♂♂, 11 ♀♀; 11–25 Sept. 1956 (R. H. Jones) light trap, 6 ♀♀; Pumpville, Apr.–May 1954 (O. Schomberg) light trap, 1 ♀. **Virginia**: Potomac River at Scott Run, Fairfax Co., 7 June 1955 (W. W. Wirth and R. H. Jones) reared from sandy river margin, 200 ♂♂, ♀♀.

Jenkinshelea magnipennis (Johannsen)
Figures 1–3

Johannseniella magnipennis Johannsen, 1908, New York State Mus. Bul. 124:268 (male; Old Forge, N. Y.).

Through the courtesy of Henry Dietrich the type series of *magnipennis* was borrowed for study from the Cornell University collection. There are two specimens, both females and somewhat teneral, the holotype in good condition but the paratype damaged with abdomen missing. The wing length of the holotype is 4.0 mm. (Johannsen gave 5 mm.). The femora and tibiae appear to be uniformly dark, probably originally blackish or dark brown. These characters will serve to distinguish *magnipennis* from *albaria* (Coquillett), which is smaller and often has the legs yellow, with both ends of the femora and tibiae brown.

Specimens examined.—**Connecticut**: Storrs, 17 June 1953 (F. B. Lewis) 8 ♀♀. **Illinois**: Algonquin, 21 June 1896 (C. A. Hart) 1 ♀; Havana, 3 June 1895 (C. A. Hart) 2 ♀♀; Muncie, Stony Creek, 24 May 1914 (J. R. Malloch) 1 ♀; Urbana, 18 June 1887, 11 July 1898 (C. A. Hart) 2 ♀♀; Waukegan, 24 Aug. 1917 (J. R. Malloch) 1 ♀; (all Ill. specimens from Ill. Nat. Hist. Surv. coll.). **Michigan**: Alto, 24 July 1937 (Campaw) 1 ♀ (Sabrosky coll.; Bay City, 1 Aug. 1951 (R. R. Dreisbach) 1 ♂; Bellaire, 13 July 1939 (C. W. Sabrosky) 1 ♀ (Sabrosky coll.); Douglas Lake, Cheboygan Co., 22 July 1954, July 1959 (R. W. Williams) light trap, 1 ♂, 2 ♀♀; Lake City, July 1951, June 1952 (L. L. Curry) 7 ♂♂, 3 ♀♀; Lapeer Co., 4 July 1937 (G. Steyskal) 1 ♀ (Sabrosky coll.); Monroe, 2 July 1939 (G. Steyskal) 1 ♀ (Sabrosky coll.); Niles, 13 July 1914 (J. R. Malloch) at light, 1 ♀ (Ill. Nat. Hist. Surv. coll.). **Minnesota**: Chisago Co., 14 Aug. 1954 (O. W. Oestlund) 1 ♀. **New York**: Old Forge, 20 June 1905 (J. G. Needham) 2 ♀♀ (type and paratype, Cornell Univ. coll.); Hilton, 5 July 1940 (L. L. Pechuman) 1 ♀ (Cornell Univ. coll.). **Ohio**: Lucas Co., Adams Township, Sec. 23, 28 July 1935 (R. T. Everly) 1 ♀. **Ontario**: Kearney, 3 July 1909 (M. C. Van Duzee) 1 ♀. Ottawa, Rideau River, 29 May 1960 (W.W. Wirth) 3 ♂♂, 1 ♀. **Quebec**: Montreal, 17 Aug., 1 ♀.



Male genitalia of *Jenkinshelea:* Figs. 1–3, J. *magnipennis;* Figs. 4–6, J. *albaria;* Figs. 1, 4, 6, parameres; Figs. 3, 5, aedeagus; Fig. 2, genitalia, ventral view; Fig. 6, parameres of specimen from Kerrville, Tex.

IMMATURE STAGES OF THE STALK-EYED FLY, *SPHYRACEPHALA BREVICORNIS* (SAY) (DIPTERA: DIOPSIDAE) WITH OBSERVATIONS ON ITS BIOLOGY[1]

By Robert Lavigne[2]

Abstract

A review of the literature indicates a paucity of information on the biology of *Sphyracephala brevicornis.* The author observed adults emerging and copulating during April under the exposed roots of a tree on the undercut bank of a stream. From eggs obtained from mated females in vials, the immature stages were reared under laboratory conditions. These are described and figured for the first time.

Literature Review

Despite the fact that *Sphyracephala brevicornis* (Say) was described over 140 years ago, its life cycle has apparently never been determined nor its immature stages made known. Following Say, who described the species in 1817 from a single specimen captured on skunk cabbage, *Symplocarpus foetidus* (L.) Nutt., numerous authors have made brief mention of the habits and habitat of the adult. Say (1828) discovered it in profusion in crevices of rocks on the banks of the Missouri. Fitch (1855) collected adults between the leaves of skunk cabbage in May; in the previous April he had found them feeding on the sap of a newly cut maple, and later, in October, resting on the sunlit sand beside a stream at the base of a hill. He concluded that the species was apparently limited to low, shady situations. Keen (1883) took specimens from near the type locality in damp situations. Houghton (1902) collected scores of adults from skunk cabbage, bushes, and herbage along Fall Creek, Ithaca, New York. Aldrich (1905) reported finding hundreds of specimens on foliage in one of the shady glens adjoining Cornell University in midsummer. He expressed the opinion that there was no evidence to indicate that the larva was directly associated

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[2] Plant Science Division, University of Wyoming, Laramie.

with skunk cabbage from which adults had been collected. Flint (1956), making observations both in Massachusetts and New York, found adults overwintering in protected locations, sometimes in tremendous numbers.

Sphyracephala hearseiana Westwood, the life history of which was studied by Sen (1921), is the only other species of this genus whose immature stages have been described. While rearing the species through its complete life cycle under artificial conditions, Sen found that the immature stages require a semi-aquatic environment. However, he was never able to discover these stages in their natural habitat.

Observations on Adults

Adults of *S. brevicornis* were first collected by the author in the late afternoon of April 12, 1957, beneath the exposed roots of a tree on the undercut bank of a small stream (flowing out of Pulpit Hill Pond in North Amherst, Massachusetts). Beneath the overhanging bank (Text fig. 1) is a jumble of broken rocks, a situation apparently ideal for the over-wintering of these flies. Weekly observations of the location and its immediate environs

Text fig. 1. View of undercut bank where adults of *S. brevicornis* were found emerging from hibernation in North Amherst, Massachusetts.

were made from April 12 to December 3, 1957, with the exception of three weeks in September.

Observations at the above site on April 12th revealed fifty to sixty adults crawling about on the exposed roots. Several pairs were in the act of mating. Other were crawling in the grass in an apparently aimless fashion opposite the tree base. When disturbed the adults made short escape flights, rarely over one or two feet in length. Several dead adults were found entangled in the many spider webs which crisscrossed the undercutting. A single inspection of skunk cabbage plants (growing on the far side of the small pond) yielded no diopsids. Adults, many of which were mating, were observed almost daily through April 18th, but after this date no further specimens were found again until fall despite weekly observations.

On October 15th, five adults were observed crawling lethargically on the roots of the tree at the original location. From October 22nd through November 20th, 10 adults were observed at various times crawling both on the rock faces and on the exposed roots. The weather on all the days on which observations were made, with the exception of December 3rd, was unseasonably warm and sunny with temperatures reaching 54° F. Even at these temperatures most of the adults reacted very slowly and jumped only weakly when prodded, except when they were exposed to direct sunlight. No adults were found at the last observation on December 3rd. No further observations were made until the following spring because of snow cover.

On March 24th, 1958, some 15–20 adults were observed in the aforementioned locality. These adults were captured and brought into the laboratory for study, but succumbed during the night. Perhaps death was connected in some way with the sudden temperature change. Adults were observed in the field at various times over a period of three weeks. After April 13th, no more adults could be found although observations were continued on a periodic basis over the following month.

Mating Behavior

Several mating pairs in vials were observed closely in the laboratory. The pattern of behavior in all cases was similar. Preparatory to mating, the male mounts the back of the female using the front femur and tibia, in apposition, to clasp her wings at about one-sixth of the distance from base to apex. This may be the major use for the so-called "raptorial" forelegs which Hearsey

(1844) (on observing *S. hearseiana* in close proximity to aphids) suggested might be used for seizing prey. The hind tarsi are meanwhile utilized in stroking the terminal segments of the female abdomen, while the middle legs clasp the abdomen. The male copulatory organ is quickly inserted. During copulation, the male clasps the posterior segments of the female abdomen with the hind legs instead of with the middle legs which are now in constant motion stroking her abdomen. Simultaneously, the apical tergite of the female exerts a rhythmic motion, back and forth. At the completion of the copulatory act, which may last anywhere from three seconds to five minutes, the female uses her hind tarsi to push out the genital apparatus of the male.

The male occasionally remains astride the female for a minute or so after mating is completely. After leaving the female, the male rubs his genital organs with his hind tarsi. The membranous organ of the male is protruded to some extent during this process. Then the tarsi of all the legs, first one pair and then the next, are rubbed together alternately, and finally the front two pairs are passed through the mouthparts.

The flies, while in the process of mating, are in some respects less responsive to the external environment. Darkening one end of the vial and bringing a lamp close to the opposite end had no apparent effect on the mating pairs, whereas those adults not copulating were drawn to the light. Similarly, in the field there was no readily observable reaction to movement or to light changes on mating pairs, while non-copulating adults reacted quickly, jumping and gliding a distance of one to two feet when disturbed.

Spring Survival of Adults

In the hope of determining how long adults may live after emergence from hibernation, flies were introduced onto various types of substrate in the laboratory. Extensive tests could not be conducted, however, because of the small number of insects available. Groups of three or four adults, including at least one mated female, were placed in 6-dram vials containing different substrates as follows: netting, filter paper, pine needles, black mud, dead grass, and sphaghum moss, the latter over mud from the fly site. All substrates were moistened daily. Netting stretched across the mouth of each vial prevented escape. Honey was tried as a possible source of nutrient; the flies accepted it readily.

Of the various substrates tested, flies lived the longest in the two vials containing sphagnum moss over mud, probably because of the property of moss to retain moisture. The longest single survival period was 43 days in one vial (April 18th to May 31st) and 52 days in the other (April 18th to June 9th). Since no specimens survived as long as two months, it would appear that overwintering adults probably do not survive through the summer in the latitude of Massachusetts.

Observations on Immature Stages

Eggs were first discovered by the writer on May 7th, 19 days after the adults were placed in the vials described above. Eggs occurred both on the black mud substrate and on sphagnum moss. Selection of an egg deposition site is probably not dependent upon moisture alone, since no eggs were found on the other moistened substrates. The eggs were laid singly, no more than nine in a vial, and in some cases appeared to be cemented to the spears of moss.

None of the eggs hatched in the vial containing only mud, whereas five of the eggs deposited on the sphagnum moss did. Larvae were first observed on May 26th in both vials which contained a sphagnum moss cover over mud collected at the fly site. The average larval developmental period appears to be about 10 days at room temperature, although one mature larva had not pupated 20 days after hatching. The larvae seem to thrive best in an environment with a very high moisture content, indicating a probable semi-aquatic existence in the field. Sen advanced the same idea in reference to *S. hearseiana.* The larvae, in both cases, apparently feed on decaying organic matter.

The first pupa was observed on June 14th. This specimen and those which pupated during the following days appeared to be cemented to the spears of moss indicating that the pupal stage may possibly require a slightly drier environment than that of the larval stage. The adults failed to emerge, however, apparently because of insufficient humidity in the vials, or other unsatisfactory conditions such as larval diet. Sen found that the pupal stage of *S. hearseiana* lasts from 10 to 15 days.

Probable Life History

Adults of *Sphyracephala brevicornis* have been found overwintering only in close proximity to an aquatic environment. Overwintering sites, e.g. cliffs, road cuts, overhangs, and fractured limestone formation (as observed by the author and other writers), offer protection from the elements, particularly from rainfall and radical temperature changes.

Spring activity in the latitude of Amherst can be noted on warm sunny days in late March or early April. Mating occurs almost immediately after the adults come out of hibernation, while they are still clustered at the overwintering site. Thus, reproduction is ensured even where only a small population exists. During the next few weeks the adults gradually disappear from the original site, apparently becoming widely dispersed. We must assume that they seek out a semi-aquatic environment where the immature stages may develop successfully.

While eggs are not known from the field, it is probable that they are laid two to four weeks after adult dispersal, judging by laboratory observations. Since egg development in the laboratory appears to require approximately three weeks, one would expect hatching not to occur until at least early June under the cooler field conditions.

Neither larvae nor pupae of *S. brevicornis* have ever been recovered in the field. However, it is possible to speculate as to their development through inference from available data. Information so far accumulated provides at least two possible views as to development of this insect.

The first view, that of a short life cycle, is indicated by the brief developmental period of the egg and larva in the laboratory. In addition, the hundreds of adults found by Aldrich in mid-summer in a shady glen in New York possibly indicate that another generation of adults emerges in July. A similarly short developmental period has actually been demonstrated in India (Sen) for *S. hearseiana,* which completes its cycle from egg to adult in only three weeks. Thus we may infer two possible generations per year for *S. brevicornis* in Massachusetts.

Other data might better be explained by an extended life cycle. Extremely few adults have been taken in the location under study by sweeping during July and August, although it has been worked heavily for many years by entomologists. Possibly the permanently cool temperatures of the semi-aquatic environment in which the immature stages may develop cause a delay in egg and larval development to such an extent that pupation and adult emergence do not occur until fall. These few adults taken during the summer could be either holdovers from the overwintering brood or early emerging members of a new generation.

The possibility must not be overlooked that the scarcity of adults during the summer months may be more apparent than real. Perhaps sweeping is too inefficient a method of collecting to disclose small populations of diopsids, and some other method should be tried. There is some evidence that sugary substances might be useful for this purpose. Fitch found adults feeding on the sap of a newly cut maple in April. Sen showed that *S. hearseiana,* in captivity, would feed on a mixture of sugar and water. The present author provided adults with honey, upon which they readily fed. It is reasonable to assume then that adults are attracted to nectar also. Collecting stations baited with any of the above-mentioned substances may provide better evidence as to the occurrence of adults in a given area during the summer months.

With the coming of fall, adults begin to appear in numbers at favorable overwintering sites. Such behavior might be explained by the extended life cycle propounded previously, which results in adult emergence in the fall, probably in close proximity to the overwintering site.

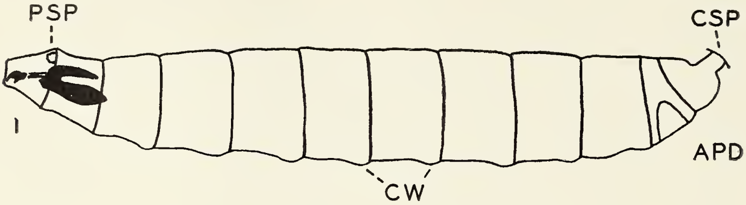
Once the adults have entered the cavities forming the overwintering sites, the majority probably remain within. However, a few specimens have been seen to reappear, crawling at or near the entrance of their hibernating quarters on unseasonably warm days in late fall. No adults have as yet been taken after the first snowfall.

Description of Immature Stages

Egg (Fig. 7): Length .08 mm., width .02 mm. Creamy white. Ovate, blunt at one end and rounded at the other. Hexagonal network of sculpture over entire surface or chorion.

Larva (Figs. 1–5): The following description is based on a single full-grown specimen. Length 5.5 mm., width .66 mm. White, except for pharyngeal skeleton, mouth hooks (Fig. 2), caudal spiracles, and ambulatory spinules; smooth except as indicated below, shining, not striated. Head telescoped into prothorax; mouth hooks dark brown; pharyngeal skeleton fading to light brown posteriorly (Fig. 2), extending caudad to anterior portion of metathorax, apparently somewhat different in proportions from that of *S. hearseiana* figured by Sen. Body 12 segmented, cylindrical, tapered anteriorly, blunt posteriorly, ending in a pair of spiracular stalks. Abdominal segments one through eight each with the apical portion of the segment projecting ventrally as an ambulatory welt; abdominal segments one through six each with similar dorsal projections. Each ventral and dorsal welt provided with transverse rows of projecting brown spinules arranged as follows: on each of segments one through eight ventrally in 9 to 11 irregular rows, each row containing approximately 60 to 80

Lavigne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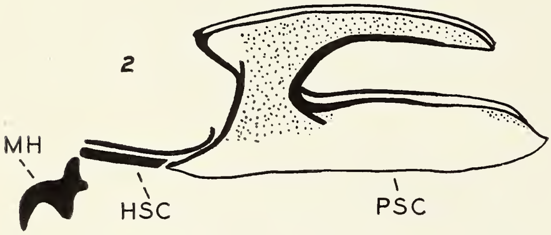
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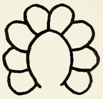
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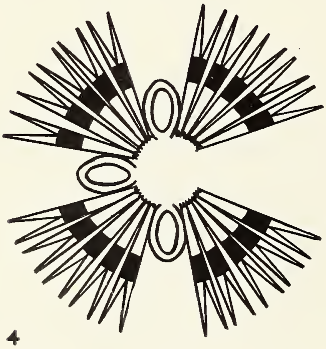
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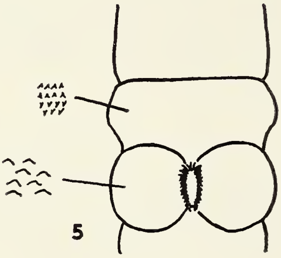
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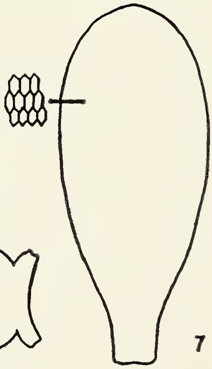
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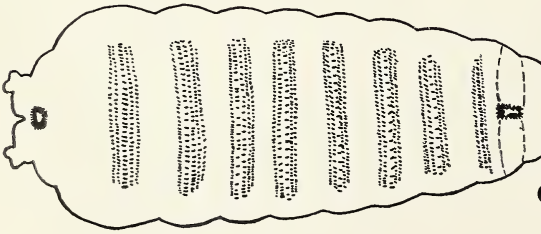
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spinules, those in rows 2, 3, 8, and 9 usually larger and more distinct; on each of segments one through six dorsally in 7 to 8 irregular rows, each row containing 60 to 80 spinules all of which are approximately the same size. The apical four or five rows of spinules of each segment directed anteriorly while the caudal four or five rows project posteriorly. Abdominal segment eight somewhat bulbous laterally and ventrally, splitting along the median line of the ventral surface to form the anal opening; the raised anal pads bordering the anal opening liberally supplied with tubercles. Anal opening (Fig. 5) a longitudinal slit the borders of which are heavily sclerotized and largely hidden by the anal pads. Prothoracic spiracles on short stalks arising from the lateral basal portion of the prothorax and bearing eight papillae arranged in a semicircle (Fig. 3). Caudal spiracles on stalks about .33 mm. in length (Fig. 1) arising from caudal segment.

From a caudal view each spiracle is surrounded by complex structures. Figure 4 is a schematic representation of these caudal spiracular plates which unfortunately is reproduced from a very rough preliminary sketch since the plates were inadvertently lost during the process of subjecting the larva to caustic potash for better observation. There are, no doubt, errors in both the number and the shape of the scale-like processes. However, the drawing has been included since these spiracular plates are so strikingly different from those of the immature stages of any other dipterous family.

Puparium (Fig. 6): The following description is based on an examination of five puparia. In general appearance, the puparium closely resembles that of *S. hearseiana* as figured by Sen. As in other Cyclorrhapha, the puparium is formed from the larval skin and the larval ambulatory spinules are easily observed. The larval mouthparts have been pushed to the side by the metamorphosing pupa but are clearly visible through the wall of the

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Explanation of Plate

Figs. 1–5, Larva of *Sphyracephala brevicornis:* 1, Lateral view of larva; CSP—caudal spiracle, APD—anal pads, CW—creeping welts, PSP—prothoracic spiracle. 2. Pharyngeal skeleton; MH—mouth hook, HSC—hypostomal sclerite, PSC—pharyngeal sclerite. 3. Prothoracic spiracle. 4. Caudal spiracle showing position of stigmatic plates and associated branched filaments. 5. Ventral view of anal area showing anal opening. Fig. 6, Ventral view of puparium. Fig. 7, Egg.

puparium. The caudal spiracular plates have been lost through the breakdown of the muscles of attachment and only the caudal spiracular stalks remain. The anal opening and the anal pads are clearly visible in potashed specimens as are also the papillae of the prothoracic spiracles.

Length 3.1 mm., width .99 mm. Color pale at first, changing to dark brown after a few days. Cylindrical; smooth except for ambulatory spinules. Both prothoracic and caudal spiracles flattened, on short, raised stalks. Borders of oral opening on ventral surface considerably darkened.

ACKNOWLEDGEMENTS

I wish to express my deep appreciation to Dr. John Hanson and Dr. Marion Smith of the University of Massachusetts for their helpful advice and criticism of this paper.

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NESTING BEHAVIOR OF SPHEX TEPANECUS SAUSSURE (HYMENOPTERA: SPHECIDAE)

By James E. Gillaspy[1]

In the fall of 1960 a resident of Alpine, Texas reported to me a colony of large, orange-winged wasps nesting in his yard. On September 7 I investigated and found one female engaged in digging. She belonged to a species of Sphecinae at that time unknown to me, but since identified as *Sphex tepanecus* Saussure [det. Arnold Menke]. The species is a strikingly colored Mexican form previously known in the United States only from Arizona (Murray, 1951, p. 972). As there appears to be no information on its life history, the observations I made seem worth reporting.

The site was an area of dry, hard, fine sandy loam soil, bare of vegetation, about 4.3 meters long in an east-west direction by about 2.0 m. wide, bounded on the north by a concrete driveway, on the east and south by walls of a wooden building, and on the west by a sidewalk. Four nest entrances were evident, each about 2.5 centimeters in diameter, with a mound of excavated soil to one side. On September 8 two nests near the driveway were excavated and found to slant downward at angles of about 45° and 75° with the surface to depths of 45 cm. and 48 cm., with no evidence of cells or prey. On September 18 one male and five females were collected in another part of town, about a mile away, visiting mainly the higher flowers (4–5 m.) of a large shrub, the chaste-tree, *Vitex agnuscastus* (Verbenaceae). On September 21 further observations were made at the nesting site. One female with prey, a green long-horned grasshopper or katydid (Tettigoniidae), was seen entering her nest in a clump of grass against the garage wall, across the driveway to the north of the original site, but was not further observed. One of the four nests originally noted was between the roof-drip line and the south wall. At 12:25 a male was near the entrance of this nest, which the female was filling from the dirt pile before it. This mound slanted from the entrance to a height of about 7 cm., and extended about 25–30 cm. from the entrance, eastward. The female left, the male remained a minute or so and then also left. At 12:35 the female reappeared carrying an immature green katydid, accompanied by a male. She alighted about 20–25 cm. from the entrance, on the dirt pile. The male immediately mounted, his abdomen curling downward, hers turned upward, bending mainly at the base of the petiole. Copulation continued in this position for about 2–3 minutes, the female still in possession of her prey, with little activity on the part of either. Finally the male fell away on his back, suspended at an angle, the parts still engaged for a time. After disengagement the female placed her prey about 13 cm. from the entrance, started opening the nest. Another wasp appeared, engaged in a swift-moving struggle with the original male, and one departed, the remaining male then mating with the female in the nest entrance. Again the female merely halted in place, this time in the act of opening the nest, and copulation took place as before, with the male falling away backward at the end of 2–3 minutes. The female then completed opening the burrow and dragged the katydid in headfirst by the antennae. The male remained until she had reappeared, closed the burrow, and left, then he also left after a short time. One male and three females were again taken from the *Vitex* on September 24, and on September 27 a female was seen engaged in closing her nest at the colony site. The last specimen taken was a freshly dead male found on a downtown parking lot on October 22.

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[1] Museum of Comparative Zoology, Cambridge, Massachussetts.

On November 26 excavation of the nesting area was undertaken. All surface indications of nesting had been obliterated by heavy rainfall and runoff from the roof which had thoroughly permeated the soil to a depth of at least 1.2 m. One tunnel, apparently produced by one of the wasps, was toward the center of the area, away from walls and driveway. It reached a depth of 74 cm., turned sharply to the horizontal, and terminated, empty. A considerable area was excavated, but the only occupied cells that were found apparently belonged to the female that had nested near the south wall, within the drip line. The soil here was drier, and it is possibly noteworthy that only one of the five burrows was not in the immediate vicinity of either a wall or the concrete driveway. Eight cocoons were found within an area about 30 cm. in diameter. Depths were 31, 39, 41, 46, 49, 51, 55, and 60 cm., and it was noted that the shallowest cocoon was in particularly moist soil and appeared soft and in poor condition. Cells were generally about 5 cm. long, 2.5 cm. in diameter (one was 3.5 cm. in diameter) and horizontal, with little evidence of access tunnels or prey remains. Cocoons ranged in length from 3 cm. to 4 cm. and in diameter from 0.8 cm. to 1.3 cm. They were elongate-oval, with a thin, light-brown outer fibrous cover and a blackish-brown, papery inner cover revealed by the microscope to consist of layered, non-fibrous, and seemingly quite water-repellent material.

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OCULAR ANOMALIES IN SPIDERS

By B. J. KASTON[1]

Structural deformities are found only rarely in spiders, but of the reports in the literature there are more concerning eyes than any other structures. In 1937 I published a very short note recording ocular anomalies in two species of spiders. In 1939 Denis reviewed all 33 cases that had been reported up to that time, and then described two additional ones. Besides citing these instances of teratology he gave a most interesting discussion of the relationship between the loss of eyes (or the reduction in their size) and the hypogean habitat. I too (1945) discussed this matter for species of *Nesticus,* and for *Scotolathys,* with the comment that the latter genus could probably not be maintained apart from *Lathys* merely on the basis of the reduced size, or absence, of the anterior median eyes. However, in other lucifugous spiders where eye loss does not normally occur a specimen occasionally is found showing the loss of one or more, and in 1946 I reported a completely blind male *Ctenium riparius* (Keyserling).

As to teratological specimens, Muma (1943) described a *Neoantistea barrowsi* Gertsch with the left anterior lateral eye missing and the other eyes displaced; Denis (1945) described a male *Entelecara congenera* (O. P.-Cambridge) in which the posterior median eyes each show a trace of doubling of the cornea; and Roth (1954) recorded a male *Barronopsis texana* (Gertsch) with the left posterior lateral eye only half the normal size. Since the appearance of my 1937 paper I have had opportunity to study nine additional specimens, which are now described. Thanks are due Dr. W. J. Gertsch of the American Museum of Natural History, and Dr. Harriet E. Frizzell, for the loan of specimens in their care. The illustrations were all prepared by my wife.

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[1] Central Connecticut State College, New Britain, Connecticut.

REPORT OF CASES

Trochosa pratensis (Emerton)

No. 1. A male, collected at Bristol, Connecticut, in September 1948 by Jeanne Cline is lacking the anterior lateral eye on the left side. As can be seen from the illustration (Fig. 1) the normal locus for this eye bears some dark pigment.

Lycosa or *Schizocosa* sp.

No. 2. The specimen is a not quite mature female lycosid collected at Port Isabel, Texas, by Harriet E. Frizzell on June 22, 1948. It was found to be lacking the right anterior median eye. But contrary to the situation in case no. 1, not a trace of dark pigment marks the locus of the missing eye (Fig. 2).

Lycosa lenta Hentz

No. 3. This is a male collected by the writer at Gainesville, Georgia, on October 24, 1945. The right posterior lateral eye is much smaller than that on the left side, its diameter being only a little more than half that of its mate. Moreover, while there is much dark pigment associated with the left lateral, as well as with the posterior median eyes, there is none around the abnormal eye (Fig. 3).

Trochosa pratensis (Emerton)

No. 4. This is a female collected by the writer at Farmington, Connecticut, on September 10, 1935. Here, the two anterior median eyes are conjoined (Fig. 4), instead of being separated by about a diameter, as is usual.

Pachygnatha tristriata C. L. Koch

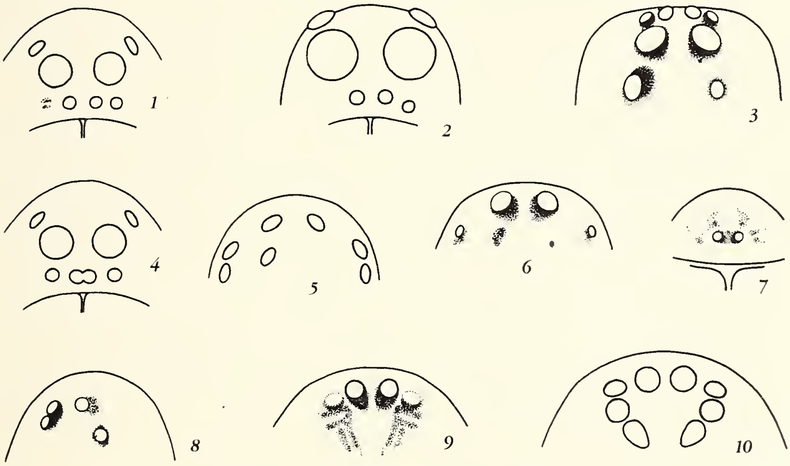
No. 5. A female of this species was collected by George H. Plumb at Portland, Connecticut, on March 16, 1936. It was found to lack the right posterior median eye. Moreover, there is no trace of dark pigment to mark the locus of the missing median eye (Fig. 5).

Tetragnatha laboriosa Hentz

No. 6. The specimen is a male collected by the writer at New Haven, Connecticut, in July 1935. Normally in this species the lateral eyes are about as far apart as the medians, and the diameter of an anterior lateral eye is about half that of an anterior median. In this specimen the anterior medians are apparently normal. The anterior laterals are reduced in size, the diameter of each being only about one third that of an anterior median rather than one half. In addition all of the posterior eyes are missing. The place where the left posterior median eye should be is marked by a large area of pigment, that where the left posterior lateral should be by more diffuse pigment, that where the right posterior median should be by a very small spot of pigment, and where the right lateral should be is completely devoid of pigment. (Fig. 6).

Amaurobius ferox (Walckenaer)

No. 7. The specimen is a male collected by K. W. Cooper at Princeton, New Jersey, on October 14, 1939. It has only two eyes, the anterior medians (or "direct") eyes, and they appear quite normal. The remaining six (or "indirect") eyes are repre-



Explanation of Figures

Fig. 1, *Trochosa pratensis,* eye area from in front. Fig. 2, young lycosid, eye area from in front. Fig. 3, *Lycosa lenta,* eye area from above. Fig. 4, *Trochosa pratensis,* eye area from in front. Fig. 5, *Pachygnatha tristriata,* eye area from above. Fig. 6, *Tetragnatha laboriosa,* eye area from above. Fig. 7, *Amaurobius ferox,* eye area from in front. Fig. 8, *Hypselistes florens,* eye area from above. Fig. 9, *Prodidomus* sp., eye area from above. Fig. 10, *Prodidomus rufus,* eye area from above.

sented only by some diffuse dark pigment as can be seen in Figure 7.

Hypselistes florens (O. P.-Cambridge)

No. 8. This is a not quite mature male collected by Harry L. Johnson at South Meriden, Connecticut, in April 1936. It has only four eyes, and these are quite asymmetrically disposed over the ocular area. The left laterals both appear to be normal, but the right laterals are missing. Also lacking are the right anterior median eye and the left posterior median eye. There is no trace of dark pigment to mark the positions of the four missing eyes (Fig. 8).

Prodidomus sp.

No. 9. The specimen is a not quite mature female collected at Negritos in Peru by Harriet E. Frizzell on March 12, 1939. The eye group is symmetrical, but with only the row of four anterior eyes present. Of these the laterals are not as well developed as the medians. The locus where each posterior should be is marked with some diffuse dark pigment as shown in Figure 9. For comparison Figure 10 shows the normal appearance of the eye group in *Prodidomus rufus* Hentz.

Other Cases

In addition to the above nine cases seen by me I can report the following of which I have heard. Some years ago the late Dr. William Morton Barrows told me of seeing a male of the trap-door spider, *Ummidia carabivorous* (Atkinson), which had only six eyes. The anterior medians, which are small when present, were lacking in this case. More recently, Dr. H. Homann, in studying the histology of eyes, reported (*in litt.*) a case of *Oxyptila* sp. devoid of a tapetum; a *Pachygnatha* sp. with one posterior median eye deformed; and a specimen of *Oxyopes* sp. with the rhabdome pushed far forward into the lens.

Discussion

An analysis of the nature of the anomaly in each of the 48 cases now known reveals that there is an extremely wide range of diversity. Moreover, we cannot with assurance offer an explanation for the anomalies. Nor does it follow that the causative agent is the same for any two showing the same type of deformity.

The situation reported most often (six cases) is that in which a posterior median eye is missing. Of the six cases that have been reported that of Denis' in *Amaurobius erberi* Keyserling is similar to my case number 5 in that the eye on the right side is the one involved. There have been four cases of complete absence of eyes (not counting, of course, the troglobiotic species in which this condition is encountered more frequently), and a similar number where a posterior lateral eye is missing. The next most frequently reported type of anomaly (two cases for each) is that in which *both* posterior median eyes, or *both* anterior median eyes are missing.

The situation where the posterior lateral eye on the right side is smaller than the one on the left (as in my case number 3) was described once before (by Blackwall) in a specimen of *Xysticus bifasciatus* C. L. Koch. That where the second row of four eyes is completely lacking (as in my case number 9) was described by Fox in a *Lycosa* sp. There has been one other case of conjoined eyes (somewhat similar to my case number 4). This appeared in a specimen of *Zodarion fuscum* (Simon) and was reported by Denis (1939). There the posterior lateral eye and the posterior median eyes on the left side were involved, and, of course, produced an asymmetrical condition as compared with the perfectly symmetrical eye group in my *Trochosa,* as seen in Figure 4.

My remaining cases are of types not previously reported in the literature. It is interesting to note that the situation present in my case number 7 is the exact opposite of what occurs ordinarily in lucifugous spiders. In the latter the tendency is for the anterior medians to be lost first, the remaining six generally being retained.

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ANTILLEAN SPECIES OF *HYDROPSYCHE* (TRICHOPTERA)

By Oliver S. Flint, Jr.[1]

The types of *Hydropsyche calosa* Banks and *H. domingensis* Banks which are located at the Museum of Comparative Zoology (MCZ), and a few undetermined specimens of the same genus from Cuba and Hispaniola which are located at the MCZ and the United States National Museum (USNM), provide the basis for the present paper.

As so often happens in collections of *Hydropsyche,* the majority of specimens are female. However, the specific characters of the female genitalia in this genus have been elucidated by Denning and by Ross for the North American species. Using the same type of characters as found valid by these workers, I am able to distinguish seven species from Cuba and Hispaniola. Of the seven species, males are known for only two.

The presence of seven species in one genus on these two islands is unique in the Antillean Trichoptera. In all other genera only one or two species are presently known from an island. I do not believe that this number of species is the result of a large number of independent invasions. *H. antilles* Ross and Palmer and *H. domingensis* Banks appear to have had origins distinct from the remaining five closely interrelated species.

Key to Antillean *Hydropsyche* Species

1. Apex of abdomen with claspers and an aedeagus (males) . . . 2
   Abdomen lacking claspers and aedeagus (females) 3
2. Aedeagus with 2 pairs of long processes apically (Ross & Palmer, Fig. 2, 3) . . . . *antilles* Ross & Palmer
   Aedeagus without long processes (Fig. 1B, C) . . *calosa* Banks
3. A hollow, spherical structure internally near top of clasper groove (Fig. 5) . . . . *antilles* Ross & Palmer
   No such structure present 4
4. Ninth tergite very narrow; clasper receptacle very small, located near posteroventral angle of ninth tergite (Fig. 4) *domingensis* Banks
   Ninth tergite wider; clasper receptacle large, located more centrally on ninth tergite 5
5. Ninth tergite greatly widened ventrally; clasper receptacle and

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[1] Smithsonian Institution, Washington, D. C.

groove very large, almost semicircular in outline (Fig. 3) *cubana,* n. sp.

Ninth tergite but slightly widened ventrally, clasper receptacle and groove nearly linear 6

6. Clasper receptacle with a ridge (Fig. 7) ..... *carinifera,* n. sp.

No ridge on clasper receptacle 7

7. Clasper groove evenly rounded dorsally; clasper receptacle curving sharply to posterior from top of groove (Fig. 1D) *calosa* Banks

Clasper groove with a dorsal projection; clasper receptacle continuing nearly same axis as groove 8

8. Clasper receptacle obliquely placed on ninth tergite, in close contact with anterior margin of tergite (Fig. 2) *darlingtoni,* n. sp.

Clasper receptacle nearly vertical on ninth tergite, remote from anterior margin of tergite (Fig. 6) .... *batesi,* n. sp.

Hydropsyche calosa Banks

Fig. 1

Hydropsyche calosa Banks, 1938, Rev. de Entomologia 9: 300–301

Figures and descriptions of the male and female genitalia of this species are presented here to supplement the original description. The figures are drawn from the holotype male and a paratype female.

Male: Foretarsi without cluster of apical black spines. *Genitalia:* Ninth segment annular, bearing numerous setae along posterior margin. Tenth tergite short and broad; setal wart near middle extending depth of tergite, produced into a free lobe dorsally and with 2 small supplementary lobes along anterior margin. Clasper divided into 2 segments subequal in length, basal one considerably inflated near apex, apical one curving dorsally and mesally near apex. Aedeagus inflated basally; apex with a pair of lateral concave lobes and a thin dorsal hood basad of lobes.

Female genitalia: Ninth tergite sinuate anteriorly, vertical axis about 3 times length of horizontal axis. Clasper groove long, rounded dorsally. Clasper receptacle curving posteriorly from top of groove and developed into a narrow extension along anterior margin of groove.

The species is still known only from the type series collected in Cuba.

Hydropsyche darlingtoni, n. sp.

Fig. 2

The female genitalia and habitus of this species show it to be closely related to *calosa* Banks. The female may be recognized by the more sinuate anterior margin of the ninth tergite, the nipple-like projection dorsally from the clasper groove, and the straighter clasper receptacle.

Female: Length of forewing, 8.5 mm. Brown; wings mostly denuded, but with a few brown and cream-colored hairs. *Genitalia:* Ninth tergite with vertical axis about 2½ times length of horizontal axis, anterior margin strongly sinuate. Clasper groove long, with a dorsal nipple-like projection. Clasper receptacle with a long narrow extension along anterior margin of groove and a deep quadrate dorsal portion.

Holotype female: Cuba, Hanabanilla Falls, Trinidad Mountains, April 30, 1936, P. J. Darlington. MCZ type number 30407.

Hydropsyche cubana, n. sp.
Fig. 3

Although *cubana* is related to *darlingtoni* most closely, it is very distinctive. The very large, rounded, clasper groove and receptacle are unlike any other Antillean species.

Female: Length of forewing, 8.5 mm. Brown; wings irrorate with brown and cream-colored hairs. *Genitalia:* Ninth tergite greatly widened ventrally, vertical axis about 1½ times length of horizontal axis, anterior margin very sinuate. Clasper groove large, round, opening posteroventrally. Clasper receptacle surrounding groove for a rather uniform depth on all except posteroventral margins.

Holotype female: Cuba, Oriente, Sierra Maestra near Rio Yao, 800′, October 1941, C. V. Morton. USNM type number 65935.

Hydropsyche domingensis Banks
Fig. 4

Hydropsyche domingensis Banks, 1941, Mem. de la Soc. Cubana de Hist. Nat. 15: 398.

The type series of this species is composed of three female specimens, the first labelled holotype. In his original description Banks figured a male; this specimen is no longer to be found. To judge from Banks' figure of the male clasper, his male is probably to be associated with either *batesi* or *carinifera* rather than *domingensis*.

The species is illustrated and described from a female compared with and found identical to the female holotype.

Female genitalia: Ninth tergite rather narrow, vertical axis about 5 times length of horizontal axis. Clasper groove poorly defined. Clasper receptacle placed very near center of segment, divided into a dorsal trianguloid portion and a short vertical, linear portion.

In addition to the type series, I have seen a series of six females from San Francisco Mountains, Santo Domingo, West Indies, September 1905, August Busck, that are in the USNM.

Hydropsyche antilles Ross & Palmer
Fig. 5

Hydropsyche antilles Ross & Palmer, 1948, Proc. Ent. Soc. Wash. 48: 182–184.

This species appears to be unique in the structure of the aedeagus of the male and in the possession of an internal sphere in the female. Although the original description and figures are excellent, a figure and description of the female is given here in order to facilitate comparison with the other species.

Female genitalia: Ninth tergite with the vertical axis little more than twice the length of horizontal axis, anterior margin only slightly sinuate. Clasper groove long, poorly indicated ventrally, dorsally tapering to a sharp point. Clasper receptacle very shallow, developed for a short distance along anterodorsal and posterodorsal margins of groove. A spherical, hollow structure internally near apex of groove and connected thereto by a short tube. (This structure is called the clasper receptacle by Ross & Palmer, but I do not think it is homologous with the clasper receptacle. The structure may be used by one of the pairs of processes on the aedeagus during copulation).

I have seen 2 females and 1 male of this species in the MCZ labelled Haiti, Diquini, W. M. Mann.

Hydropsyche batesi, n. sp.
Fig. 6

H. batesi is the largest species yet described from the Antilles. The female genitalia is very similar to that of *carinifera,* but the clasper receptacle does not bear a carina.

Female: Length of forewing, 13 mm. Brown; wings closely irrorate with brown and white hairs. *Genitalia:* Ninth tergite with vertical axis nearly 3 times length of horizontal axis, only slightly sinuate anteriorly. Clasper groove roughly quadrate, dorsal margin with a slender mesal projection. Clasper receptacle extending

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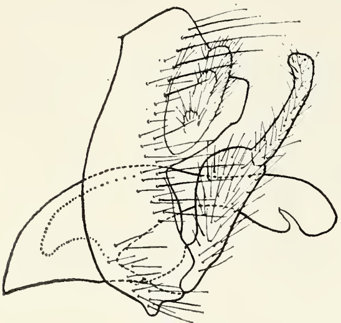

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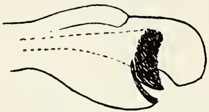

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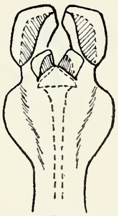

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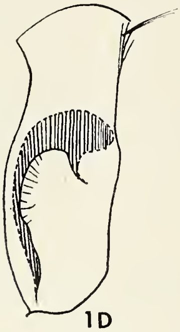

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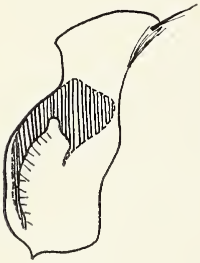

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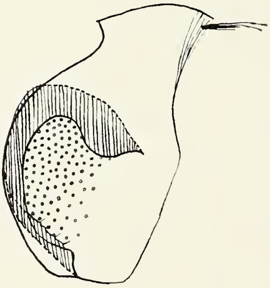

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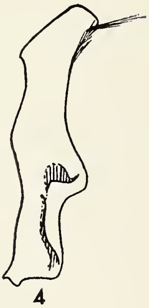

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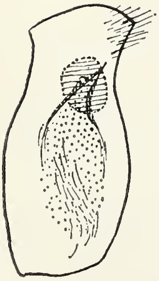

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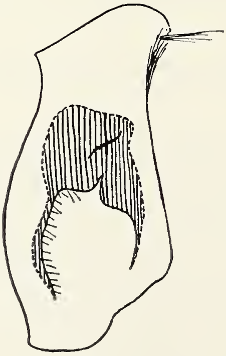

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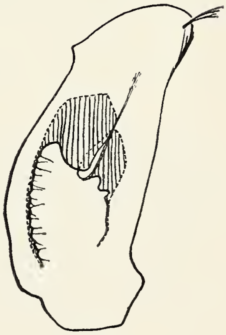

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shallowly along anterior and posterior borders of groove, deep and rather quadrate dorsally.

Holotype female: Haiti, LaVisite and vicinity, La Selle Range, 5–7000′, 16–23 September 1934, M. Bates. MCZ type number 30408.

Hydropsyche carinifera, n. sp.
Fig. 7

This species is closely allied to the preceeding, but is smaller and the clasper receptacle bears a distict ridge.

Female: Length of forewing, 9 mm. Brown; wings mostly denuded but with a few brown and cream-colored hairs. *Genitalia:* Ninth tergite with the vertical axis nearly three times as long as the horizontal axis, anterior margin slightly sinuate. Clasper groove long, dorsal margin oblique, highest anteriorly, rather sinuate posteriorly. Clasper receptacle very shallow anteriorly and posteriorly, deep and pentagonal dorsally. A carina present near middle of receptacle, extending from inside receptacle onto the outside of receptacle and onto tergite.

Holotype female: Dominican Republic, foothills Cordillera Central, South of Santiago, June 1938, P. J. Darlington. MCZ type number 30409.

EXPLANATION OF PLATE

Fig. 1, *Hydropsyche calosa* Banks: A, male genitalia, lateral; B, apex of aedeagus, lateral; C, apex of aedeagus, ventral; D, female ninth tergite, lateral. Fig. 2, *H. darlingtoni,* n. sp., female ninth tergite, lateral. Fig. 3, *H. cubana,* n. sp., female ninth tergite, lateral. Fig. 4, *H. domingensis* Banks, female ninth tergite, lateral. Fig. 5, *H. antilles* Ross & Palmer, female ninth tergite, lateral. Fig. 6, *H. batesi,* n. sp., female ninth tergite, lateral. Fig. 7, *H. carinifera,* n. sp., female ninth tergite, lateral.

LECTOTYPES OF NEARCTIC AND NEOTROPICAL ZETHINI IN EUROPEAN AND AMERICAN MUSEUMS (HYMENOPTERA: VESPIDAE)

By R. M. Bohart and L. A. Stange
University of California, Davis

Type specimens of most of the American species of the genus *Zethus* Fabricius sensu lato have been examined as a preliminary to a revision. Many of these were studied by the senior author during a visit to museums in Western Europe in 1960. In addition curators of several museums, both in Europe and in South America have kindly lent types for our more leisurely appraisal. Furthermore, we have been particularly fortunate in having seen the large and important W. J. Fox collection at the Carnegie Museum, Pittsburgh. In this paper we are intending to fix the names only for species presently based on syntypes. J. Bequaert (1928, Ann. Mag. Nat. Hist. (Ser. 10) 2: 138–176) designated specimens of some of these species in the British Museum. However, since he used the terms "holotype" and "allotype," we have included lectotype designations for his "holotypes" to avoid confusion. As the most definitive characters are found in the males we have selected this sex as lectotype when possible. The remaining conspecific syntypes which we have seen have been considered as lectoparatypes, and they have been labeled as such. Repository museums with the identifying names or symbols in parentheses are as follows:

Zoologische Museum, Humboldt University, East Berlin, Germany (Berlin); British Museum (Natural History), London, England (B.M.N.H.); Carnegie Museum, Pittsburgh, Pennsylvania (Carnegie); Universitetets Zoologische Museum, Copenhagen, Denmark (1. Copenhagen Coll. and 2. Kiel Coll.); Senkenbergerische Naturforschende Gesellschaft (Frankfurt); Muséum d'Histoire Naturelle, Geneva, Switzerland (Geneva); Museo Civico di Storia Naturale, Genoa, Italy (Genoa); Museu Paranense "Emilio Goeldi," Belém, Brazil (Goeldi); Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts (M.C.Z.); Museum National d'Histoire Naturelle, Paris, France (Paris); Departamento de Zoologia, Secretaria da Agricultura, Sao Paulo, Brazil (Paulista Mus.); A. Giordani Soika, Private Collection, Venice, Italy (Soika); Museo di Zoologia della Universita di Torino, Turin, Italy (Turin); Entomology Museum, University of California, Davis, California (U.C.D.); Naturhistorische Hofmuseum, Vienna, Austria (Vienna); Entomologisches Institut, Technical Hochschule, Zürich, Switzerland (Zürich).

LECTOTYPES

amazonicus Zavattari, (*Zethus*), 1913, ♂, Obidos, Amazonas, Brazil (Zürich). Topotypical lectoparatypes: 1 ♂, 1 ♀ (Zürich).

apicalipennis Zavattari, (*Zethus*), 1912, ♀, Merida, Venezuela (Genoa). Topotypical lectoparatype: 1 ♀ (Genoa).

arietis Fabricius, (*Vespa*), 1775, ♀, "Habitat in America" (Kiel Coll.). The type locality was probably the island of St. Thomas as cited by Fabricius in 1804. Lectoparatype: 1 ♀ (Kiel Coll.), no data and headless.

aurantiacus Zavattari, (*Zethus*), 1912, ♂, Minas Gerais, Brazil (Berlin). Topotypical lectoparatype: 1 ♀ (Berlin).

aztecus Saussure, (*Zethus*), 1857, ♂, Tampico, Tamaulipas, Mexico (Geneva). Topotypical lectoparatypes: 2 ♂, 2 ♀ (Geneva), 1 ♀ (B.M.N.H.); 1 ♀ (Zürich); 1 ♂ (Paris).

bicolor Fox, (*Zethus*), 1899, ♂, Chapada, Brazil (Carnegie). Topotypical lectoparatypes: 5 ♀♀ (Carnegie), 1 ♀ (U.C.D.).

binghami Zavattari, (*Zethus*), 1913, ♀, Savana Grande, Guerrero, Mexico (B.M.N.H.), designated as "holotype" by Bequaert (1928). Lectoparatype: 1 ♂, Dos Arroyos, Guerrero, Mexico (B.M.N.H.), designated as "allotype" by Bequaert (1928).

brasiliensis Fox (*Labus*), 1899, ♀, Chapada, Brazil (Carnegie).

brethesi Zavattari (*Discoelius*), 1911, ♀, San Bernardino, Paraguay (Berlin). Topotypical lectoparatype. 1 ♀ (Berlin).

buyssoni Ducke (*Zethus*), 1905, ♂, Pará, Brazil (Paris). Lectoparatypes: 1 ♀, Pará, Brazil (Paris); 2 ♀♀, one without abdomen, Teffé, Amazonas, Brazil (Goeldi).

campanulatus Fox (*Zethus*), 1899, ♀, Chapada, Brazil (Carnegie). Topotypical lectoparatypes: 3 ♀♀ (Carnegie), 1 ♀ (U.C.D.).

campestris Zavattari (*Zethus*), 1913, ♀, Rincon, Guerrero, Mexico (B.M.N.H.). This specimen was called "holotype" by Bequaert (1928).

cinerascens Saussure (*Zethus*), 1855, ♀, Brazil (Geneva). Lectoparatype: 1 ♀ topotype (Geneva).

coeruleopennis Fabricius (*Vespa*), 1798, ♂, Cayenne, French Guiana (Kiel Coll.). No locality label on type nor on ♂ lectoparatype (Kiel Coll.), without antennae. This species is the type of the genus. Fabricius, 1789, Ent. Syst. Suppl., p. 263, gave the data: "Habitat Cajennae," collection of "Dom Richard."

coloratus Fox (*Zethus*), 1899, ♀, Chapada, Brazil (Carnegie). Topotypical lectoparatypes: 2 ♀♀ (Carnegie), 1 ♀ (U.C.D.).

corallinus Ducke (*Zethus*), 1904, ♀, Pará, Brazil (Paris). Also, 1 ♀, Obidos, Pará, Brazil, February 22, 1903, (Goeldi) which is apparently a metatype.

corcovadensis Zavattari (*Zethus*), 1913, ♀, Corcovado, Brazil (B.M.N.H.). Topotypical lectoparatype: 1 ♂ (B.M.N.H.). The ♀ lectotype was designated as "holotype" by Bequaert (1928).

coriarius Fox (*Zethus*), 1899, ♀, Chapada, Brazil (Carnegie).

cruzi Zavattari (*Zethus*), 1913, ♂, Santa Catherina, Brazil (Zürich). Topotypical lectoparatype: 1 ♀ (Zürich).

curialis Zavattari (*Zethus*), 1913, ♀, Corcovado, Brazil (B.M.N.H.), designated as "holotype" by Bequaert (1928). Lectoparatypes: 1 ♂ topotype (B.M.N.H.), designated as "allotype" by Bequaert (1928); 1 ♀, Guaruja, Brazil (B.M.N.H.).

cyanipennis Fabricius (*Vespa*), 1793, ♀, Cayenne, French Guiana (Kiel Coll.).

cylindricus Fox (*Zethus*), 1899, ♂, Chapada, Brazil (Carnegie). Topotypical lectoparatypes: 1 ♂, 2 ♀♀ (Carnegie); 1 ♂ (U.C.D.). Lectoparatype; 1 ♂, Corumbá, Brazil (Carnegie).

dicomboda Spinola (*Epipona*), 1851, ♂, Chile (Paris). Topotypical lectoparatypes: 3 ♀♀ (Paris); 1 ♂, 1 ♀ (Turin). These 6 specimens were part of the Claudio Gay collection.

felix Zavattari (*Zethus*), 1912, ♀, Bogota, Colombia (Berlin no. 20105). Topotypical lectoparatype: 1 ♀ (Berlin no. 20372).

geniculatus Spinola (*Didymogastra*), 1853, ♂, Pará, Brazil (Turin). Topotypical lectoparatype: 1 ♀ (Turin). These specimens were collected by D. Ghiliani.

guatemotzin Saussure (*Zethus*), 1857, ♂, Cordoba, Vera Cruz, Mexico (Geneva). Topotypical lectoparatypes: 3 ♂♂ (Geneva).

hexagonus Fox (*Zethus*), 1899, ♀, Chapada, Brazil (Carnegie).

hilarianus Saussure (*Zethus*), 1855, ♀, Goyaz State, Brazil (Paris). Lectoparatypes: 2 ♀♀ (Paris). All type material labeled "du midi de la Capite de Goyaz," Brazil.

histrionicus Zavattari (*Zethus*), 1912, ♀, Costa Rica (Genoa). Lectoparatype: 1 ♀. Guatemala (Paris).

inermis Ducke (*Zethus*), 1905, ♂, Almeirim, Amapá, Brazil (Paris). Lectoparatypes: 1 ♀, Pará, Brazil (Paris); 1 ♂ Obidos, Pará, Brazil (Goeldi); 1 ♀, Amapá, Brazil (Goeldi).

infelix Zavattari (*Zethus*), 1912, ♀, Bogota, Colombia (Berlin no. 20106). Topotypical lectoparatype: 1 ♀ (Berlin no. 20104).

infundibuliformis Fabricius (*Eumenes*), 1804, ♂, "Amer. Merid." (Copenhagen Coll.). Lectoparatype: 1 ♂ (Kiel Coll.) without abdomen.

lunaris Zavattari (*Zethus*), 1912, ♂, Cauca, Colombia (Berlin). Topotypical lectoparatypes: 3 ♂♂, 1 ♀, (Berlin).

miniatus Saussure (*Zethus*), 1858, ♂, Pará, Brazil (Geneva). Topotypical lectoparatype: 1 ♀ (Geneva).

minimus Zavattari (*Zethus*), 1912, ♀, Mendoza, Argentina (Berlin). Topotypical lectoparatypes: 3 ♀♀ (Berlin). These specimens were all collected by Jensen-Haarup.

niger Saussure (*Zethus*), 1853, ♀, Cayenne, French Guiana (Geneva). Both sexes were described originally. The lectotype is a headless ♀ without locality label but bearing de Saussure's identification label.

nigricornis Saussure (*Zethus*), 1875, ♂, Cordoba, Vera Cruz, Mexico (Geneva). Lectoparatypes: 2 ♂♂, Orizaba (Geneva). The originally cited locality was "Mexico, the eastern Cordillera. Orizaba."

notatus Fox (*Zethus*), 1899, ♀, Santarem, Brazil (Carnegie).

olmecus Saussure (*Zethus*), 1875, ♂, Orizaba, Vera Cruz, Mexico (Geneva). Topotypical lectoparatype: 1 ♀ (Geneva).

orans Zavattari (*Zethus*), 1913, ♂, Santa Catherina, Brazil (Zürich). Lectoparatypes: 1 ♀ topotype (Soika); 1 ♂, Alto da Serra, Sao Paulo, Brazil (B.M.N.H.).

otomitus Saussure (*Zethus*), 1875, ♂, Orizaba, Vera Cruz, Mexico (Geneva). Lectoparatypes: 2 ♂, Orizaba (Geneva); 1 ♂, Orizaba (Zürich); 1 ♂ "Mexique" (Paris). Originally, there were 6 ♂♂ from "Mexico; the Oriental Cordillera. Orizaba."

poeyi Saussure (*Zethus*), 1857, ♂, Cuba (Geneva). Topotypical lectoparatypes: 2 ♀♀ (Geneva).

productus Fox (*Zethus*), 1899, ♂, Chapada, Brazil (Carnegie). Topotypical lectoparatypes: 7 ♀♀ (Carnegie), 2 ♀♀ (U.C.D.).

prominens Fox (*Zethus*), 1899, ♀, Chapada, Brazil (Carnegie). Topotypical lectoparatype: 1 ♀ (M.C.Z.).

proximus Fox (*Zethus*), 1899, ♀, Corumbá, Brazil (Carnegie).

punctatus Fox (*Zethus*), 1899, ♂, Chapada, Brazil (Carnegie). Topotypical lectoparatypes: 8 ♀♀, 2 ♂♂ (Carnegie), 1 ♀ (U.C.D.) 1 ♂, 1 ♀, Corumbá, Brazil (Carnegie), 1 ♂ (U.C.D.).

pyriformis Spinola (*Zethus*), 1841, ♂, Cayenne, French Guiana (Paris). Lectoparatype: 1 ♀, no data but presumably the same as the ♂ (Paris). Spinola originally cited 1 ♂ and 2 ♀♀.

rufinodus Latreille (*Eumenes*), 1806, ♂, "Antilles" (Paris). Topotypical lectoparatype: 1 ♀ (Paris).

rufipes Fox (*Zethus*), 1899, ♂, Chapada, Brazil (Carnegie). Topotypical lectoparatype: 1 ♂ (Carnegie), 1 ♂ (M.C.Z.).

schrottkyanus Ihering (*Zethus*), 1911, ♂, Camaquam, Rio Grande do Sul, Brazil (Paulista Mus.). Topotypical lectoparatype: 1 ♀ (Paulista Mus.).

sessilis Fox (*Zethus*), 1899, ♂, Chapada, Brazil (Carnegie). Topotypical lectoparatypes: 1 ♂, 10 ♀♀ (Carnegie), 1 ♀ (M.C.Z.), 2 ♀♀ (U.C.D.).

simillimus Fox (*Zethus*), 1899, ♀, Chapada, Brazil (Carnegie). Topotypical lectoparatype: 1 ♀ (Carnegie).

smithii Fox (*Zethoides*), 1899, ♂, Chapada, Brazil (Carnegie).

solaris Zavattari (*Zethus*), 1912, ♀, Guayaquil-Quito, Ecuador (Berlin). Topotypical lectoparatype: 1 ♀ (Zürich).

spiniventris Ducke (*Zethus*), 1905, ♂, Pará, Brazil (Goeldi). Topotypical lectoparatypes: 1 ♂, 1 ♀ (Paris); 1 ♀ (Goeldi).

spinosus Saussure (*Zethus*), 1857, ♀, Tampico, Vera Cruz, Mexico (Geneva). Topotypical lectoparatypes: 1 ♂ (Frankfurt): 3 ♀♀ (Vienna); 1 ♂ (Genoa); 1 ♀ (B.M.N.H.); 2 ♂♂, 4 ♀♀ (Paris); 1 ♂ (Turin).

striatifrons Fox (*Zethus*), 1899, ♂, Chapada, Brazil (Carnegie). Topotypical lectoparatypes: 2 ♀♀ (Carnegie), 1 ♀ (M.C.Z.), 1 ♀ (U.C.D.).

strigosus Saussure (*Zethus*), 1875, ♂, Orizaba, Vera Cruz, Mexico, (Geneva). Topotypical lectoparatypes: 2 ♀♀ (Geneva), 1 ♂ (Berlin).

subspinosus Zavattari (*Zethus*), 1912, ♂, Barbacena, Minas Gerais, Brazil (Goeldi). Topotypical lectoparatype: 1 ♀ (Goeldi).

variegatus Saussure (*Zethus*), 1853, ♀, "Mexique" (Geneva). Lectoparatypes: 6 ♂♂, 7 ♀♀, South Carolina, Georgia, Tennessee (Geneva).

venezuelanus Zavattari (*Zethus*), 1912, ♀, Merida, Venezuela (Genoa).

PUBLICATIONS RECEIVED

The Scolytoidea of the Northwest, by W. J. Chamberlin, 216 pp., 255 figs. 1958. Oregon State Monographs: Studies in Entomology No. 2 (Price $2.50).

The Stoneflies (Plecoptera) of the Pacific Northwest, by S. G. Jewett, Jr., 95 pp., 33 figs. 1959. Oregon State Monographs: Studies in Entomology No. 3 (Price $2.00).

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The Biology and Taxonomy of the Genus Trichiotinus, Hoffmann. 76 pp., 20 figs. 1935	$ 2.00
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A Monograph of the Melophaginae, or Ked-Flies of Sheep, Goats, Deer and Antelope, Bequaert. cloth bound, 210 pp., 18 figs. 1942.	$ 5.00
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The Hippoboscidae or Louse-Flies of Mammals and Birds, Part I. Structure, Physiology and Natural History, Bequaert, 442 pp., 21 figs., 1952–53.	$10.00
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Vol. LVII APRIL, 1962 No. 2

UNDESCRIBED SPECIES OF NEMATOCEROUS DIPTERA. PART XI.[1]

By Charles P. Alexander, Amherst, Mass.

The preceding part under this general title appeared in December 1961 (Bul. Brooklyn Ent. Soc. 56: 121–127). In the present paper I am describing species of Tipulidae from various insular sources, as follows:

Saint Helena, in the Atlantic ocean, 1100 miles from the African coast, collected by Arthur Loveridge; kindly presented to me by Dr. Phillip J. Darlington, Jr.; 15° 57′ S. Lat.; 5° 42′ W. Long.

Isla San Ambrosio, in the Pacific ocean, north of Juan Fernandez, collected by Padre Guillermo Kuschel; 26° 40′ S. Lat.; 80° W. Long.

Isla Navarino (Navarin Island), in Beagle Canal, Tierra del Fuego, Chile, collected by Padre Kuschel; 55° 10′ S. Lat.; 67° 40′ W. Long.

I am greatly indebted to the persons cited for the privilege of studying these particularly interesting crane-flies.

TIPULIDAE

Tipula (Eumicrotipula) navarinoensis, n. sp.

Belongs to the *glaphyroptera* group; (wing of female to 10 mm.); general coloration gray, praescutum with three darker gray stripes; femora darkened at tips, broadly so on fore legs; wings yellowed, clearest on disk, extensively clouded with pale brown, including four subcostal darkenings; wing veins stout, chiefly glabrous, *m-cu* long, oblique; abdomen dark brown, lateral tergal borders broadly light gray; ovipositor with bases of hypovalvae large, scooplike.

Female: Length about 11–12 mm.; wing 9–10 mm.; antenna about 2.8–2.9 mm.

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[1] Contribution from the Entomological Laboratory, University of Massachusetts.

Frontal prolongation of head stout, brownish gray, without nasus; palpi black. Antennae 12-segmented; brownish black, in the paratypes with pedicel vaguely more yellowed; flagellar segments with basal enlargements scarcely developed; verticils shorter than the segments; terminal segment subequal in length to the penultimate. Head dark brown, the front and broad orbits light gray; vertical tubercle not developed; anterior vertex broad, subequal in diameter to the exposed part of eye.

Pronotum gray, broadly dark brown on sides. Mesonotal praescutum gray, with three darker gray stripes, the interspaces vaguely more darkened; posterior sclerites of notum gray, each scutal lobe with two separated brown areas; scutellum and mediotergite with a narrow brown central line; mesonotum unusually glabrous, with sparse pale setae on scutellum and mediotergite. Pleura and pleurotergite light gray, ventral sternopleurite darker, dorsopleural membrane yellowed. Halteres brownish yellow, knob infuscated. Legs with coxae light gray; trochanters obscure yellow; fore femora chiefly brownish black, yellowed basally, remaining femora brownish yellow, the tips narrowly darkened; tibiae and tarsi brownish yellow, outer tarsal segments darkened; claws very small, simple. Wings with the ground yellowed, extensively clouded with pale brown, especially in outer radial field, along vein *Cu* in cell *M*, and near outer ends of Anal cells; region of cell *Sc* with four darkenings that are subequal to or more extensive than the yellowed interspaces; center of wing disk more whitened; stigma variegated, the base yellowed, outer end infuscated; veins brown, subcostal interspaces yellow. Costal fringe short and dense; veins stout, chiefly glabrous, with trichia on veins R, R_1, R_3, outer half of R_{4+5} and outer end of M_1; a series of trichia on distal section of Cu_1. Venation: *Rs* long, straight, slightly less than twice the long oblique *m-cu*, the latter at fork of M_{3+4} or on base of M_4; length of petiole of cell M_1 variable, in cases much longer than *m*.

Abdomen dark brown, lateral tergal borders broadly light gray. Ovipositor with cerci relatively short and straight; hypovalvae with basal shield very large, scooplike, the outer valves flattened.

Habitat: Chile (Tierra del Fuego).

Holytype: ♀, P. Williams, Isla Navarino, Beagle Canal, 600 meters, 7 Jan. 1959 (Guillermo Kuschel). *Paratopotypes:* 3 ♀♀ with the type.

The previous discussion of Fuegian Tipulidae[2] provides a key to the species by which the present fly runs to *Tipula* (*Eumicrotipula*)

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[2] Alexander C. P. Arkiv för Zoologi, 13, no. 6: 1–32, 20 figs.; 1920.

magellanica Alexander, a quite distinct fly. The still poorly understood *T.* (*E.*) *pictipennis* Walker and *T.* (*E.*) *varineura* (Bigot) are much larger flies with the antennal pedicel conspicuously yellowed. As I have indicated previously it seems possible that both of these names apply to a single species, the former having priority. The present fly appears to have the wings slightly reduced and it may be that the males will be found to have proportionately larger wings.

Limonia (Dicranomyia) sanctae-helenae, n. sp.

Size large (wing about 9 mm.) ; general coloration of mesonotum gray, praescutum with four brown stripes, pleura restrictedly lined with dark brown; halteres yellow, base of stem narrowly infuscated; femora obscure yellow, with a brown nearly terminal ring; wings marmorate, pale brown, variegated by yellowed areas along the veins and patterned with dark brown spots, the veins alternately yellow and dark brown, cell *1st A* with two dark brown spots; male hypopygium with the ventral dististyle small, rostral spines elongate; mesal-apical lobe of gonapophysis slender, nearly straight.

Male: Length about 7–7.5 mm.; wing 8.5–9 mm.

Female: Length about 7–8 mm.; wing 9–9.5 mm.

Rostrum relatively long, black; palpi black. Antennae with basal two segments black; remainder of organ broken. Head gray; anterior vertex subequal to or a little broader than the diameter of the scape.

Pronotal scutum dark brown, scutellum more yellowed, especially laterally. Mesonotum gray, praescutum with four pale brown stripes, the intermediate pair nearly confluent, darker anteriorly; scutal lobes brownish gray, centers darker; scutellum and postnotum gray. Pleura yellowish gray, narrowly lined with dark brown, including a longer dorsal line extending from propleura to base of halteres, the ventral stripe including most of fore coxa and an area on sternopleurite. Halteres yellowed, base of knob narrowly patterned with brown. Legs with coxae extensively darkened, tips pale; trochanters pale yellow; femora obscure yellow with a virtually terminal brown ring; tibiae and proximal two tarsal segments yellow, outer segments brownish black; claws relatively small, outer spine largest, nearly one-half as long as the apex of claw, with about six progressively smaller more basal denticles. Wings marmorate, ground pale brown, variegated by cream yellow areas along each vein; a conspicuous darker brown pattern, as follows: arculus, midlength of cell *Sc,* fork of *Sc* and origin of *Rs,* at midlength of vein R_1, R_2 and R_{1+2}; cord and outer end of cell *1st* M_2 darkened; a series of marginal spots at ends of all longitudinal veins; a second brown spot in cell *1st A* at near midlength of vein *2nd A;* veins light yellow, conspicuously dark brown in the spotted parts, producing a checkered appearance. Macrotrichia on veins beyond the general level of origin of *Rs,* lacking on *Sc, M* and virtually all of Cu_1, present at tips of both Anal veins. Venation: Sc_1, ending opposite origin of *Rs*, Sc_2 near tip of Sc_1; R_{1+2} about one-half longer than R_2; *Rs* straight, about twice the basal section of R_{4+5}; cell *1st* M_2 long and narrow, subequal to outer section of M_{1+2}; *m-cu* usually close to fork of *M*, in cases up to one-half its length before this fork.

Abdomen dark brown, genitalia of both sexes obscure fulvous. Male hypopygium with posterior border of tergite narrowly emarginate, producing two broadly rounded lobes, their borders broadly thickened, provided with unusually long setae. Basistyle with ventromesal lobe relatively slender. Dorsal dististyle a stout gently curved rod, the tip acute; ventral style small, its area less than one-half that of the basistyle, body small, prolongation slender, spines two, unusually long, placed at base of prolongation, directed outwardly. Gonapophysis with mesal-apical lobe very slender, nearly straight, lower margin microscopically crenulate.

Habitat: Saint Helena.

Holotype: ♂, Varney's, at light, 17 June 1961 (Arthur Loveridge).

Allotopotype: ♀, with the type. *Paratopotypes:* ♂♂♀♀, with the types.

Limonia (*Dicranomyia*) *sanctae-helenae* is quite distinct from all other regional species, superficially being most similar to flies such as *L.* (*D.*) *tipulipes* (Karsch) or *L.* (*Idioglochina*) *marmorata* (Osten Sacken). In the nature of the wing pattern, especially the paired darkened spots along vein *2nd A,* the species agrees closely with members of the *punctulata* group, widely distributed in the Old World Tropics, and including chiefly species of small size. The most similar member of this group is *L.* (*D*) *guamicola* Alexander, of Micronesia, entirely different in the structure of the male hypopygium and other features.

Limonia (Dicranomyia) loveridgeana, n. sp.

Size large (wing 8 to 9 mm); general coloration brown; rostrum, palpi and legs uniformly black; wings strongly darkened, stigma slightly deeper in color, Sc_1 ending about opposite origin of *Rs*, Sc_2 near its tip; male hypopygium with the ventral dististyle large and fleshy, its area exceeding four times that of the basistyle; rostral spines two or three in number; mesal-apical lobe of gonapophysis long and slender.

Male: Length about 6–7.5 mm.; wing 8–9 mm.

Female: Length about 7 mm.; wing 8.5 mm.

Rostrum and palpi black. Antennae with scape and pedicel black; flagellum broken. Head dark brownish gray; anterior vertex narrow, about two-thirds the diameter of scape.

Pronotum dark brown. Mesonotal praescutum dark brown medially, the sides and scutal lobes in cases more yellowed; scutellum brownish gray, postnotum more yellowed, especially the pleurotergite. Pleura dark brown dorsally, including the dorsopleural region and anepisternum, the sternopleurite, pteropleurite and metapleura more yellowed. Halteres dusky, knobs dark brown. Legs with the fore coxae dark brown, remaining coxae and all trochanters obscure yellow; remainder of legs black; claws relatively long, with four spines, the outer one longest, the more basal ones progressively smaller. Wings strongly and uniformly darkened, unpatterned except for the oval slightly darker stigma; veins brown. Longitudinal veins beyond general level of origin of *Rs* with macrotrichia, lacking on *Sc* and *1st A,* present on outer ends of *M* and *2nd A.* Venation: *Sc* short, Sc_1 ending about opposite origin of *Rs,* Sc_2 near its tip; *Rs* nearly straight, more than twice the basal section of R_{4+5}; cell *1st* M_2 variable in length, in cases about as long as the distal section of vein M_3, in other instances shorter; *m-cu* close to fork of *M;* cell *2nd A* very broad on basal half.

Abdomen brown, sternites somewhat more yellowed. Male hypopygium with the tergite transverse, posterior border very gently emarginate, lobes very low, with abundant long setae. Basistyle relatively small; ventromesal lobe large, with a smaller more darkened lobule in its outer angle. Dorsal dististyle a gently curved rod, the tip acute. Ventral dististyle very large and fleshy, its area more than four times that of the basistyle; rostral prolongation relatively slender; rostral spines slightly variable in length, placed on side of prolongation at near midlength; usually two in number, in cases with three such spines, all slightly separated. Gonapophyses with mesal-apical lobe long and slender, the small apex narrowly blackened.

Habitat: Saint Helena.

Holotype: ♂, Varney's, at light, 17 June 1961 (Arthur Loveridge). *Allotopotype:* ♀, pinned with type. *Paratopotypes:* 6 ♂♀, associated at light with *Limonia* (*Dicranomyia*) *sanctae-helenae,* n. sp.

I take pleasure in naming this interesting fly for Dr. Arthur Loveridge, to whom I am indebted for several interesting African Tipulidae in past years. The fly is quite distinct from other species previously described from the Ethiopian region, being likewise different from the rather numerous members of the subgenus known from the Canary Islands.[3] Superficially the species strongly suggests *Limonia* (*Dicranomyia*) *stygipennis* (Alexander) of Hawaii which actually is a very different fly.

Limonia (Idioglochina) ambrosiana, n. sp.

Size medium (wing of male to 7 mm.); general coloration of thorax brownish black; rostrum and antennae black, flagellar segments short-oval, verticils reduced; knobs of halteres yellowed; legs brownish black; wings strongly darkened, restrictedly patterned, Sc_2 far retracted; male hypopygium with posterior border of tergite very shallowly emarginate; rostral spines two; mesal-apical lobe of gonapophysis unusually long and slender, nearly straight, tip obtuse.

Male: Length about 5–5.5 mm.; wing 6.5–7 mm.; antenna about 1.3–1.4 mm.

Female: Length about 6.5 mm.; wing 8 mm.

Rostrum stout, black; mouthparts, including palpi, black. Antennae black; scape elongate; basal flagellar segments subglobular, the outer ones passing into short-oval; segments longer than the reduced verticils, with indications of very short pale apical necks. Head brownish black; anterior vertex about as broad as the diameter of scape.

Prothorax brownish black. Mesonotum almost uniformly brownish black, the lateral praescutal borders narrowly brown, posterior sclerites more brownish black; vestiture of notum very reduced, on the praescutal interspaces short and sparse. Pleura brownish black, pteropleurite and pleurotergite slightly paler. Halteres with base of stem and the knob yellowed, remainder of stem dark brown. Legs with coxae brownish black; trochanters dark brown; remainder of legs brownish black to black, femoral bases vaguely paler, somewhat dilated; claws with about three long slender teeth. Wings strongly darkened, restrictedly patterned with still darker brown, most evident at stigma, origin of *Rs*, a costal area over Sc_2, cord and in the axillary angle. Sparse scattered macrotrichia on longitudinal veins beyond general level of origin of *Rs;* a few trichia at tips of Anal veins, especially *2nd A.* Venation: Sc_1 ending opposite origin of *Rs*, Sc_2 greatly retracted to near midlength of the vein, Sc_1 alone longer than *Rs;* cell *1st* M_2 longer than any veins beyond it; *m-cu* at or before fork of *M;* cell *2nd A* broad.

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[3] Santos Abreu, D. Elias. Monografía de los Limonidos de las Islas Canarias. Mem. Real Acad. Cien. Artes Barcelona (3) 18: 1–132, 25 figs., 4 col. plates; 1923.

Abdomen, including hypopygium, dark brown. Ovipositor with cerci elongate, slender, nearly straight. Male hypopygium with the tergite transverse, posterior border very gently emarginate, borders thickened, including also a narrower central strip. Basistyle with ventromesal lobe stout, with unusually long setae. Dorsal dististyle nearly straight, tip acute. Ventral dististyle broad on basal half, the outer lobe strongly narrowed, tip obtuse, basal setae larger; rostral prolongation obtuse, the two blackened spines placed on outer margin, slightly separated, their tips extended into hairlike points. Gonapophysis with mesal-apical lobe unusually long, slender, nearly straight, tip obtuse. Aedeagus stout, apex narrowed, bilobed.

Habitat: Isla San Ambrosio, Chile.

Holotype: ♂, in shore caves, 9 Nov. 1960 (Guillermo Kuschel). *Allotopotype:* ♀, pinned with the type. *Paratopotypes:* 18 ♂♀, in shore caves and at light, 7–9 Nov. 1960 (Kuschel).

Limonia (*Idioglochina*) *ambrosiana* belongs to the less specialized group of the subgenus, with the antennal flagellum only slightly modified from the normal *Limonia* type. The most similar regional species is *L.* (*I.*) *porteri* (Alexander) of the Chilean mainland at Antofagasta. This is a pale brown fly with the legs light brown, differing in other details including the terminal position of vein Sc_2. The male sex of *porteri* still is unknown. The remaining more than twenty known species of the subgenus are quite distinct. All known species of *Idioglochina* are marine in their early stages, being restricted to lands in the Pacific and Indian oceans. The only other New World species is the Nearctic L. (*I.*) *marmorata* (Osten Sacken) of Pacific coastal United States and Canada.

PUBLICATIONS RECEIVED

Guide to the Insects of Connecticut. Part VI. The Diptera or True Flies of Connecticut. Seventh Fascicle: Psychodidae, by L. W. Quate. Conn. State Geol. and Nat. Hist. Surv. Bul. 92: 1–54, 7 pls.

THE IMMATURE STAGES OF PALEAGAPETUS CELSUS ROSS (TRICHOPTERA: HYDROPTILIDAE)

By Oliver S. Flint, Jr.[1]

The genus *Paleagapetus* was created by Georg Ulmer in 1912 for *rotundatus* Ulmer described from the Baltic Amber. Banks in 1936 described the first living species, *nearcticus,* from the Pacific Northwest, and Ross added *celsus* from the Great Smoky Mountains of North Carolina in 1938. Schmid described a third species, *guppyi,* from Vancouver in 1951.

As the name implies, the genus had been considered close to the glossosomatid genus *Agapetus*. The genus had thus remained until 1956 when Ross removed it to the Hydroptilidae, where he established a separate primitive subfamily, the Ptilocolepinae, for this genus and the European *Ptilocolepus*.

The immature stages of the European *Ptilocolepus granulatus* (Pictet) have been well known since 1904 when Thienemann presented an excellent description of the larvae and pupae. However, the immatures of *Paleagapetus* have remained unknown until now.

The association of stages is based on a mature female pupa collected on June 7, 1961, Indian Gap, Tennessee.

Larva.—Length 4–5 mm., width 1 mm. Slightly flattened, widest at the fourth or fifth abdominal segment. Membranous portions white, sclerites deep brown. *Head:* Deep brown, yellowish around eyes; setae arranged as in Fig. 1. Anterior gular sclerite roughly triangular, extending posteriorly about half the length of gular suture; anal gular sclerite very small. Labrum brown; setae 1 and 2 small (lost in anterolateral brushes); anterior margin deeply emarginate mesally (Fig. 4). Mandibles black, stumpy; small mesal brush in the right one, large brush in the left one (Fig. 5). Sclerites of the maxillo-labium pale brown; submentum divided (Fig. 6). *Thorax:* Each segment dorsally covered by two deep

Explanation of Plate

Fig. 1, Larval head, dorsal. Fig. 2, Larva, dorsal. Fig. 3, Larval case, dorsal, showing overlap of liverwort fragments. Fig. 4, Larval labrum, dorsal. Fig. 5, Larval mandibles, ventral. Fig. 6, Larval maxillo-labium, ventral. Fig. 7, Pupal labrum and mandibles, dorsal. Fig. 8, Larval anal proleg, ventro-laterally. Fig. 9, Larval foreleg and propleuron, posterior.

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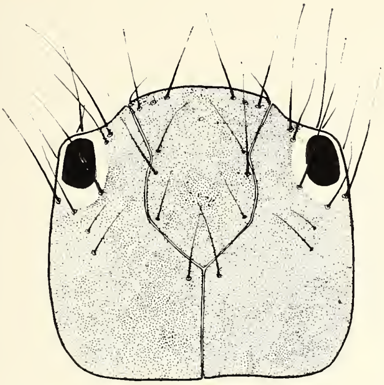
[1] Division of Insects, Smithsonian Institution, Washington 25, D.C.

Flint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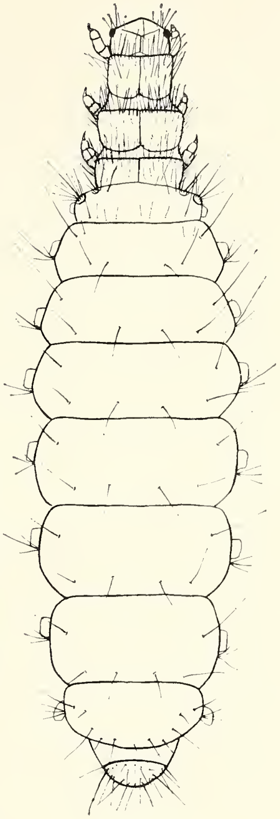
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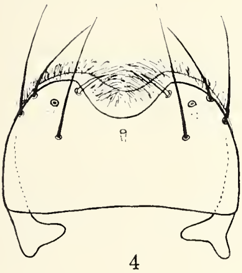
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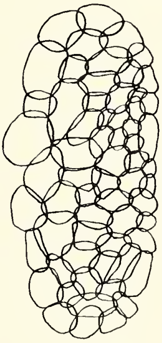
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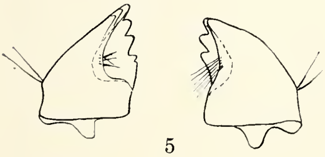
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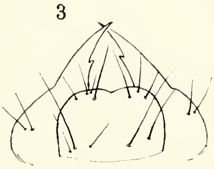
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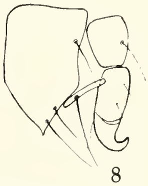
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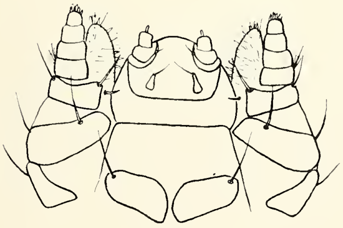
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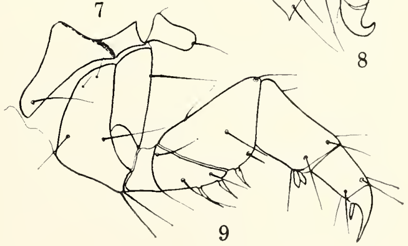
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brown sclerites each bearing many setae, especially anteriorly and laterally; posterior margin of pronotum black. Meso- and metapleura similar to the propleuron (Fig. 9), except epimeron extending further posteriorly and trochantin shorter. Legs brown, similar to fore leg (Fig. 9). Two wide, pale setae arising ventrally from a raised base on the trochanter, one similar seta on the femur; tarsi with two enlarged apical spurs; no trochanter with well developed apical brush. No sternal plates or tubercles. *Abdomen:* Without dorsal sclerites; membrane white with reddish (in alcoholic specimens) maculations dorsally. Setae arranged as in Figure 2; ventrally with an anteromesal pair of setae on each segment. A small nipple-like process sublaterally on segments 1–8. Ninth tergite brown, semicircular, with many long setae (Fig. 2). Sclerites of anal prolegs brown, claw without accessory teeth (Fig. 8).

Pupa.—Length 4.5 mm., width 1 mm. Labrum anteriorly emarginate; two groups of setae both apically and basically (Fig. 7). Mandibles with a single mesal tooth (Fig. 7). Hook plates present anteriorly on segments 3–7, posteriorly on 3–5. Abdomen tapering to a truncated apex in the female; males with distinct lobes containing genital parts.

Case.—Length 5–6 mm., width 1.5–2 mm. Flattened dorsoventrally; top and bottom halves attached along lateral margins only. Made of small fragments of liverwort (Fig. 3). Pupal case smaller, closed along entire margin; with secondary ridges dorsally and ventrally, thus becoming rather quadrate in cross-section.

Material examined.—North Carolina: Mount Mitchell, Camp Alice, 5789′; 3 larvae, 1 pupa, 9 June 1961 (Flint) (USNM). Great Smoky Mountains National Park, Indian Gap; 4♂, 1♀, 7 June 1961 (Flint) (USNM). *Tennessee:* Great Smoky Mountains Park, Indian Gap; 60 larvae, 2 pupae, 19 May 1959 (Flint & Matthews) (Flint Collection); 37♂, 9♀, 95 larvae, 8 pupae, 7 June 1961 (Flint) (USNM); 6 adults, 1 July 1958 (Flint & Hanson) (Flint Collection).

Biology.—The larvae were found in small, seeping springs. The waters as they rose seeped through sticks and stones that supported a luxurious growth of liverwort on their upper surfaces. It was in this liverwort, almost invariably above the water surface in the pupal stage or slightly above or below in the larval stage, that the immature stages were found. The liverwort has been tentatively determined as *Scapania nemorosa* (L.) Dum. by R. R. Ireland of the Smithsonian Institution.

Larvae were collected from May 19 to June 9. The adults were swept from the vegetation over and around the springs from June 7 to July 1. The remainder of the life cycle is unknown.

Other caddisflies found in the springs were: *Rhyacophila* sp., *Parapsyche apicalis* (Bks.), *Neophylax nacatus* Denn., *Goerita semata* Ross, and *Lepidostoma excavatum* Flint & Wiggins.

Systematics.—The structure of the larvae of *Ptilocolepus* and *Paleagapetus* is very similar. They are unquestionably hydroptilids, as is shown by the three sclerotized thoracic nota, lack of gills, possession of cases, and fusion of anal prolegs to the sides of the tenth segment. Yet the short mandibles, each bearing a mesal brush, divided submentum, similar structure and setal pattern of all legs, and case structure, are all very distinctive. The erection of a separate subfamily in the Hydroptilidae for these genera seems to be fully justified by the larval structure.

The pupae of both genera are rather similar also. The arrangement of the hook plates and unmodified apex of the abdomen are typically hydroptilid. However, the presence of a tooth on the mandibles and the large number of setae on the labrum are not found elsewhere in the Hydroptilidae.

Thienemann (1904) considered *Ptilocolepus* to be a somewhat annectant form between the Hydroptilidae and the Glossosomatidae. Certain of the characters that distinguish the Ptilocolepinae from the Hydroptilinae are found also in the Glossosomatidae: divided submentum in the larvae, toothed mandibles and numerous labral bristles in the pupae. Nielsen (1948) considered the Hydroptilinae to show certain characters that indicate a closer relationship to the Glossosomatidae than to any other family. Thus, it is not surprising that the more primitive subfamily would show an even closer relationship to the glossosomatids.

The larvae of the two genera are easily separated by the possession of a large sclerite dorsally on the first abdominal segment of *Ptilocolepus*. The pupae of *Ptilocolepus* have two teeth on each mandible, *Paleagapetus* only one.

In the keys of Ross (1944, 1959) the larvae will key to the Hydroptilidae, where they may be immediately recognized by the divided submentum and structure and setation of the legs. The pupae key to the Glossosomatidae in these keys, but may be distinguished by the possession of hook plates posteriorly on segments three to five. The habitat and larval and pupal cases allow easy recognition of this species in the field.

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DR. JAMES H. McDUNNOUGH

The Society records with sorrow the death of Dr. James H. McDunnough in Halifax, Nova Scotia, on February 23, 1962, in his 86th year. Dr. McDunnough was an Honorary Member of the Society and one of America's leading lepidopterists.

Born in Toronto and educated in Germany, he was associated with Dr. William Barnes of Decatur, Illinois, in the development of the great Barnes Collection, now in the United States National Museum. In 1917, he joined the Canadian Department of Agriculture, serving as Chief, Systematic Section, of the Division of Entomology. Retiring thirty years later, he went to the American Museum of Natural History as a research associate for three years and then in the same capacity to the Nova Scotia Museum of Science in Halifax where he continued active until a short time prior to his death twelve years later.

In his various affiliations, he contributed greatly to our knowledge of Lepidoptera through the publication of many scientific papers. Among his major works were Contributions to the Natural History of Lepidoptera and a Check List of Lepidoptera, a revised Check List of Lepidoptera which is the standard list currently, and monographs on various groups in the Noctuidae and Geometridae.

A GYNANDROMORPH OF *BOMBUS FLAVIFRONS* CRESSON (HYMENOPTERA: APIDAE)

By H. E. Milliron[1]

In a recently published paper (Bul. Brooklyn Ent. Soc. 55: 109–113, 1960), the writer called attention to the rare occurrence of gynandromorphs in the large group of social insects known as bumblebees, and at that time decribed the first such specimen representing a species of the closely related inquiline bumblebees, making a total of only eight then recorded for the two bee groups. A short time ago, it was his good fortune to detect another gynandromorphic specimen in a small lot of bees submitted by Professor Verne Grant, Rancho Santa Ana Botanic Garden, Claremont, California. The interesting specimen described in part beyond was captured by Professor Grant, on *Gilia pinnatifida* Nutt. at Ward, Boulder County, Colorado, July 13, 1961. This ninth gynandromorphic specimen in this particular bee series best fits the category that is designated as the frontal type. In order to avoid confusion, the use of the specific name *flavifrons,* in its usual combination, is preferable in this case and until the appearance of my revisional work on these bees.

The following descriptive remarks include the principal combined features of this specimen, as compared with those of normal individuals: *Head*—Represents the worker (*i.e.*, the usual non-reproductive female) in all details of structure, including that of the appendages. *Thorax*—This region proper, and the wings are as in an ordinary worker. *Legs*—The front pair, and the left middle leg are also like those of a worker. The right middle leg, to and including the femur, is worker but the remainder is neither typical of worker nor male; the tibia is rather more strongly attenuated at both ends and is a little shorter than that of a normal worker, and its pubescence, in character and color, is more inclined to be like that of the male; the corresponding basitarsus, including its pubescence, is also suggestive of the male except that it is comparatively a little shorter and wider with stronger longitudinal concavity on the outer surface than is characteristic of this segment in that sex, and the remainder of the tarsus, including the claws, is male-like except that each segment is a trifle shorter. The left hind leg approaches that of a normal worker, but differs in several respects; the outer surface of the somewhat longer tibia is slightly narrower, more irregularly convex and less smooth along its median longi-

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[1] Entomology Research Institute, Research Branch, Department of Agriculture, Ottawa, Canada.

tudinal area, and possesses some additional erect hairs inside the marginal fringes which are, however, like those of the worker; the corresponding basitarsus, which has a straight posterior margin, is comparatively longer and thicker, has a less strongly incised distal end, a more weakly concave outer surface, and a smaller auricle, and the remainder of the tarsus has thicker segments than in the normal worker, but the relative lengths of these latter still are the same as those for that caste. The right hind leg has the femur and segments beyond the basitarsus like the counterparts on the opposite side; its tibia does have the general outline and type of dorsal (posterior) fringe of a worker, but the outer surface and ventral (anterior) fringe are similar to those in the male; the basitarsus is noticeably shorter and narrower than its left counterpart, but tends to be more worker than male. *Abdomen*—Except for the length of pubescence, this region is structurally male throughout, including normal, typical genitalia.

The specimen measures 9.0 mm. in length, which is a little below the average for the worker, and considerably under the average for the male. The color of pubescence on the head and thorax is the same as that of typical workers to which the above specific name is currently applied, and the color of the abdominal pubescence agrees with that often found on both sexes. The physical appearance, as it concerns length, texture and density, of the body pubescence throughout, is, however, more characteristic of the vestiture of a worker rather than that of a male. Specimen deposited in the Canadian National Collection, Ottawa.

THE TORRE-BUENO GLOSSARY

The Brooklyn Entomological Society announces the third and enlarged reprinting of J. R. de la Torre-Bueno's Glossary of Entomology which first appeared in 1937. Supplement A which was compiled and edited by George S. Tulloch and published in 1960 has now been incorporated with the parent work in a single hard-cover maroon binding. This 1962 printing of the Glossary is priced at $7.00. Copies may be ordered from Mr. R. R. McElvare, P. O. Box 386, Southern Pines, North Carolina, or Mr. George S. Tulloch, 1637 Hendrickson Avenue, Merrick, New York. Copies of the 1960 Supplement A are also available for $1.00.

CLOEON DIPTERUM (L.) IN OHIO (EPHEMEROPTERA: BAETIDAE)

By Jay R. Traver
University of Massachusetts

Cloeon dipterum (Linn.)

Ephemera diptera Linnaeus, 1761, Fn. Suec. ed. 2, No. 1477; 1767, Syst. Nat. ed. 12, pars 2,906.

Burks (1953) in his important paper on the mayfly fauna of Illinois reports the presence in that State of a single female imago of *Cloeon dipterum* (L.). He says of it: "the single female specimen from Illinois is probably an adventive." A description of the male imago of this species, based on specimens collected in Switzerland, and that of the female imago taken in Illinois, are included in Burks' paper. The above appears to be the first record of the type species of the genus *Cloeon* in North America. *Cloeon dipterum* is a common species in many parts of Europe, and one which exhibits a considerable amount of variation in color and color pattern, particularly in the male. Eaton (1885) gives a lengthy account of *C. dipterum*, with detailed descriptions of both sexes and notation on the color variants, as well as a complete synonymy for the species. Ulmer (1932) figures the abdomen of male and female and presents a brief summary of the specific characters.

In the summer and early autumn of 1960, many specimens of a baetid mayfly were captured in Lucas, Richland County, Ohio, attracted by lights on the porch of a home in that town. The females, many of which appeared at first sight to be rather pale in color, proved on closer examination to be strongly and distinctively marked with reddish or blackish brown, and with the costal margin of the wing distinctly tinged with grayed orange or dull amber color. Males taken at the same time and place were almost black: they were so much darker than the females as to appear at first to be of a different species, especially as the wing lacked the tinted costal margin. In the females, the cross veins extending in three irregular rows across the disc of the wing were blackish and much thicker than the adjacent longitudinals; in the males, these veins were but slightly thickened, yet still noticeably darker than the longitudinals. In Burks' key to the species of the genus *Cloeon* in Illinois, these specimens fall to the species *dipterum*. A careful comparison of male and female imagos from Lucas, Ohio, with Eaton's excellent and detailed descriptions seems to leave no doubt that these baetid mayflies are indeed *Cloeon dipterum*.

Variations in color and color pattern fall well within the limits for the European forms, as indicated by Eaton. Legs of the males are amber yellow, fore legs darker, faintly tinged with reddish in some specimens; tips of fore femora brownish; all femora either with subapical reddish brown band or with small spot of color in same area, and with narrow longitudinal black pencilings on surface. Claws brownish; tarsal segments usually narrowly darker. Wings faintly tinged with amber in the stigmatic area, in some but not in all males; C, Sc and R faintly amber brown, other longitudinals as far as the cubito-anals paler but still evidently brownish; cross veins slightly darker than the longitudinals but barely thickened; marginal intercalaries faintly brownish, darker on some specimens. Most of the males represent the darker form of Eaton's Variation I: abdomen wholly dark brown, or with paler triangles submedially on mid-tergites, also laterally on 4 or 5 through 8. In some males, the pale submedian triangles on the tergites are more distinct; dark oblique stripes extend laterally on each side from these triangles; the mid-abdominal sternites are translucent, paler than the dorsum, with a dark mark laterally on each, adjoining the pleural fold. In still others, however, the abdomen is paler and distinctly tinged with reddish, especially on segments 7 and 8. Tails of male pale brownish or yellowish, every third or fourth segment darker basally and in the middle; apically, segments not darkened at the joinings. Genitalia are typical of the species, as figured by Eaton (Pl. 17, Fig. 31a).

The females agree well with Eaton's descriptions, some being largely yellowish, others "of a rosy fawn-colour or rosy grey" (Eaton), but all have the reddish or brownish black abdominal markings characteristic of the species. Legs of female much as in male, the subapical femoral band rather more prominent; in addition, a reddish brown longitudinal streak may be present near base of fore femur; narrow dark line along inner margin of tibia near base. Fore leg very slightly more than one-half the length of the wing. As noted above, cross veins in the disc of the wing are much thickened and blackish, the marginal intercalaries distinctly brown except in the cubito-anal region. These facts are evidenced also in two rather dilapidated subimago females from Europe, determined by Hagen, and presented to me through the kindness of Dr. P. J. Darlington of the Museum of Comparative Zoology, Cambridge, Mass. Cross veins in the costal, subcostal and radical spaces are white. Tails in this sex are more strongly marked than in the male, with the darker joinings continuous to tip. Near the base, some entire segments may be largely reddish brown, narrow and wide joinings alternating more or less regularly. The ground color may be tinged with reddish brown, instead of the paler yellowish of the male.

35 female imagos from Lucas, Ohio, taken from August 20 to October 6, 1960, were measured. These were arranged in seven size groups, as follows. Wing 9 mm. and body 8mm., one specimen in August; wing 8 and body 8, two in August; wing 8–8.5 and body 7–7.5, eleven in August, four in September, three in October; wing 8 and body 6.5, one in September; wing 7–7.5 and body 7, four in August, two in September; wing 7 and body 6–6.5, two in August, two in September; wing 6.5 and body 5.5, one in August, one in September. The largest female was taken on August 22; the smallest ones on August 20 and September 8.

20 male imagos taken during the same period fell into 5 categories as to size, as indicated. Wing 7 mm. and body 6.5–7.5 mm., four in August, one in September, one in October; wing 7 and body 6–6.5, two in September; wing 6.5 and body 7, one in September; wing 6–6.5 and body 6–6.5, two in August, six in September, one in October; wing 5.5 and body 5.5, two in September. The largest male was taken October 7, the smallest ones on September 21 and 27. Thus there seems to be no correlation, in either sex, between date of capture and size of the specimen. For the European forms of this species, Eaton gives 6–11 mm. for wing of male, 5–10 for body length; for females, 9–11 mm. for wing, 8–11 mm. for body. The female taken in Illinois and reported by Burks was of the same size as the largest one from Lucas, Ohio.

Representatives of both sexes of *C. dipterum* were taken on the nights of August 20 and 21, 1960, by M. A. Parsons, L. Darling and J. R. Traver. All specimens taken from August 22 to October 6 of that year were collected by Mrs. M. R. Parsons at the same location, the front porch of her home. Mrs. Parsons likewise collected what she believes to be representatives of this same species, again from her front porch, beginning in early April of 1961. These latter specimens are not yet available to me for study. It would appear that *C. dipterum* is well established in this locality in Ohio. If the early spring forms are indeed of the same species, then these insects have a relatively long period of emergence.

It is conjectured, but not yet proved, that the nymphs inhabit a small pond not far from the house in Lucas, Ohio, where all of the above specimens have been taken. Such quiet waters seem to be the usual abode of the nymphs of *C. dipterum* in Europe. Thus Eaton (p. 186) says: "In Great Britain, clean ponds that acquire a rather high summer temperature are frequented by this species;

at Paris, tanks for Nymphaeaceae and other water-plants in the Jardin des Plantes are its favourite resorts." Kimmins (1942, p. 59), writing of this species in Britain, says: "Common in ponds with a rather high summer temperature, May to September." Macan (1961) states on page 36: "Abundant in small rich ponds but also in lakes and in the slowest parts of rivers." On page 50 of the same paper, Macan, "based on unpublished information from a moorland fishpond," has this to say: "*Cloeon dipterum* overwinters as a small nymph, and there is a long period of no growth. In 1960, emergence of this generation took place in the months of June and July, and it gave rise to another overwintering one. In 1957, on the other hand, there is distinct evidence of a quick summer generation starting in July and finishing early in September." Distribution of the species in Great Britain is charted by Macan on page 58, Figure 37; likewise a summary of the life history is shown as a graph (Fig. 28d, on p. 48).

It would be of great interest to compare the life cycle and the nymphal habitat of the Ohio forms of this species with the information given above for their European relatives. For many years it has been known also that this species can be viviparous. Of this Eaton writes (p. 186): "Hitherto instances of viviparation on the part of *C. dipterum* have been observed only in the warmer parts of Italy and France." Is our climate perhaps too cold for vivipary to occur here? Certainly no evidence for it is seen in the Ohio specimens collected to date.

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VENATION IN THE ANAL FIELD OF THE BEETLE FAMILY OSTOMATIDAE[1]

By Edwin W. King[2]

In any problem involving the venation of insects it is a truism to say that the correct interpretation of specialized forms must depend on an understanding of their more generalized relatives. Examples are abundant; the present paper is an attempt to place on record an interpretation of the venation of the anal field in the wings of nine genera of Ostomatid beetles. The venational notation employed is that of Forbes (1922). The representatives of the family available for this examination are: *Calitys scabra* Thunb., *Thymalus marginicollis* Chev., *Ostoma pippingskoeldi* (Mann.), *Eronyxa pilosulus* (Cr.), *Temnochila virescens* (Fab.), *Airora cylindrica* (Serv.), *Tenebroides mauritanicus* (L.), *Corticotomus* sp., and *Nemosoma* sp.

The wing of *Temnochila* (Fig. 1) exhibits a complete (for the family) anal field and will serve as a starting point for discussion. Its anal veins are interpreted as follows. 1st A is unbranched. 2A, which originally had three brances in the Coleoptera, is reduced to two in the Ostomatids. Presumably these are $2A_{1+2}$ and $2A_3$. $2A_3$ fuses apically with $3A_1$ to form the closed wedge cell, characteristics of many beetles. 3A is two-branched, and $3A_2$ tends to shorten and be lost. 4A is invariably present as a short vein in the extreme proximal part of the jugum. It plays no part in the discussion which follows.

The overall tendency in venation in this series is as follows: to lose the wedge cell by atrophy of that part of 2A which forms its anterior margin; to align the crossvein 2a–3a with the base of 2A and the apex of $2A_3 + 3A_1$ to produce a three-part serial vein; and to flatten the Y-branching of $2A_{1+2}$ and $2A_3$, combining these segments with another crossvein into a new stem for $2A_{1+2}$ and 1A. With the exception of *Airora* and *Thymalus,* which are essentially duplicates of *Ostoma and Calitys* respectively, the wings listed above form a rather clear and instructive series.

Calitys (Fig. 2) differs from *Temnochila* in two significant respects: the Y fork of $2A_{1+2}$ and $2A_3$ flattens from about 72° to about 140°, and the crossvein between 2A and 3A becomes oblique and directly aligned with the base of 2A. In regard to each of these two conditions *Thymalus* (Fig. 3) is slightly less advanced, but on the whole quite similar to *Calitys.*

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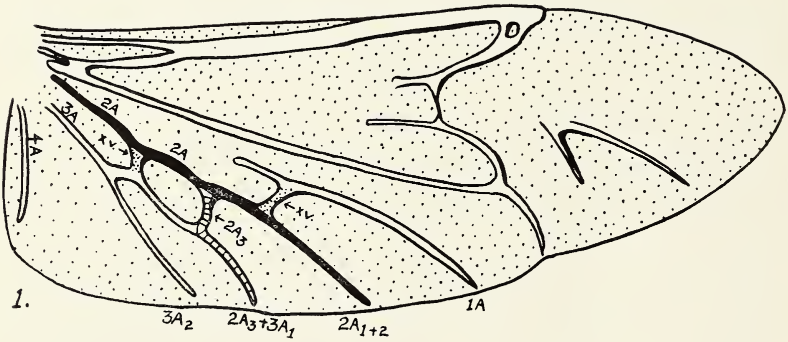
[2] Department of Entomology and Zoology, Clemson College.

Eronyxa (Fig. 4) shows clearly the next step, which is the atrophy of part of 2A and consequent dissolution of the wedge cell. A spur of 2A remains, distal to the crossvein, and one ignorant of the two preceding wings might be tempted to connect it to the backward spur of 1A. Its true point of connection, of course, is the midpoint of the vein $2A_{1+2} + 2A_3$, which now has the appearance and function of a crossvein.

Nemosoma (Fig. 5) shows greater loss of the median portion of 2A, but a less advanced condition as regards the straightening of $2A_{1+2}$ and $2A_3$. This wing shows well the alignment of the 1a–2a crossvein (if indeed it is a crossvein) with the free part of $2A_3$ and foreshadows the serial vein $2A_3 + 2A_{1+2} +$ 1a–2a + 1A.

Ostoma (Fig. 6) and *Airora* (Fig. 7) show the elongation and realignment of $2A_{1+2}$ and $2A_3$ as this vein begins to function as the stem of a new fork whose branches are 1A and $2A_{1+2}$.

Corticotomus (Fig. 8) and *Tenebroides* (Fig. 9) represent ultimate conditions in specialization, in which $3A_2$ is much reduced

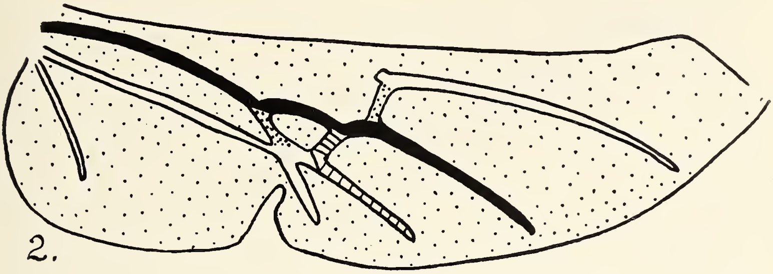


1.

EXPLANATION OF FIGURES

Fig. 1, *Temnochila virescens* (Fab.): xv., crossvein; 1A, first Anal; 2A, second Anal; 3A, third Anal; 4A, fourth Anal. Fig. 2, *Calitys scabra* Thunb. Fig. 3, *Thymalus marginicollis* Chev. Fig. 4, *Eronyxa pilosulus* (Cr.). Fig. 5, *Nemosoma* sp. Fig. 6, *Ostoma pippingskoeldi* (Mann.). Fig. 7, *Airora cylindrica* (Serv.). Fig. 8, *Corticotomus* sp. Fig. 9, *Tenebroides mauritanicus* (L.).

KING PLATE I



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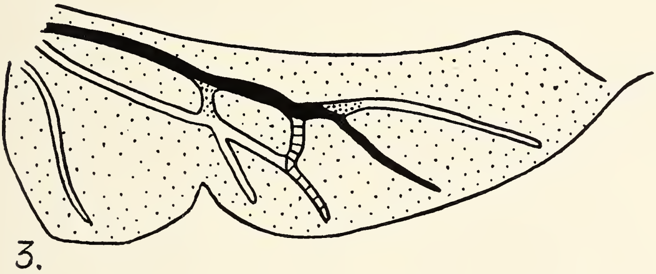

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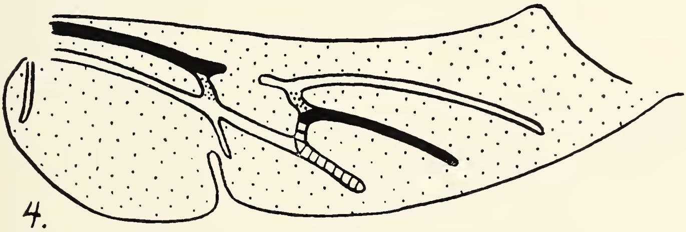

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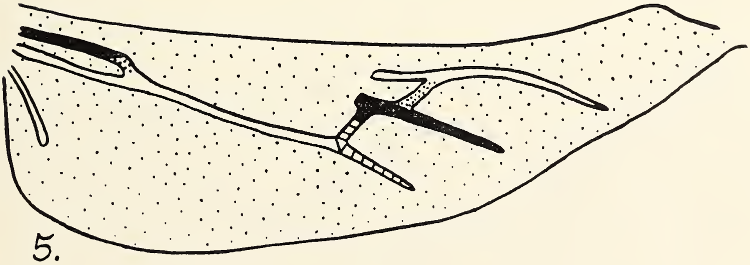

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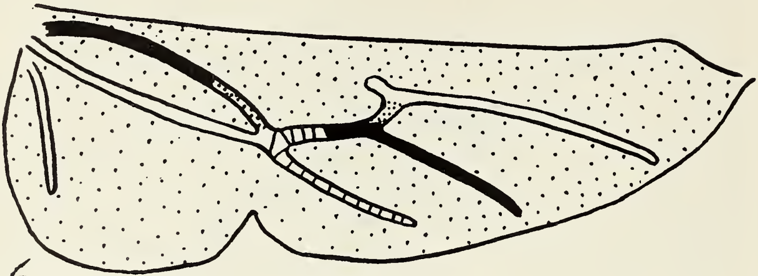
KING PLATE II



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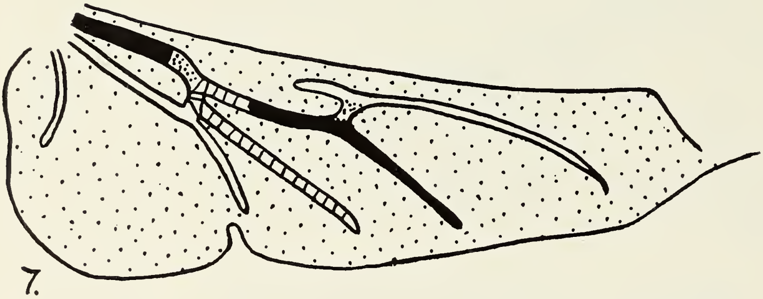

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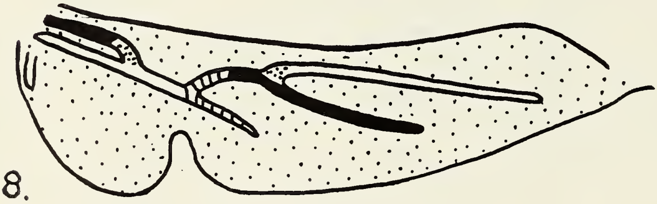

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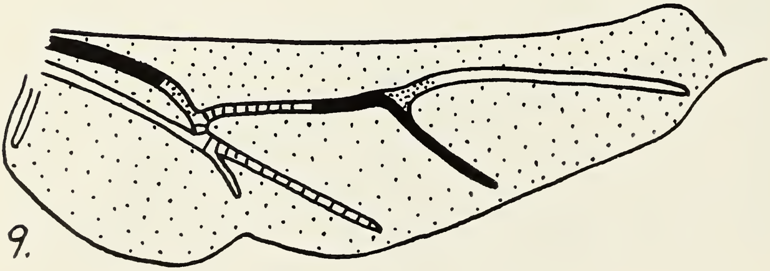

9.

and the remainder of the anal field has been resolved into a smooth, continuous, three-branched fork which supports, without functional crossveins, the vannal region of the wing.

For some of the illustrations presented here a second interpretation is possible. The designation of one or both crossveins in Figs. 2, 3, 5, 6, 7, 8, and 9 may appear to be somewhat arbitrary. In the absence of a spur of the adjacent longitudinal vein there is no means of separating longitudinal and crossveins in this family. The two criteria employed elsewhere among insects do not apply: in *Tenebroides* at least, and possibly in beetles in general (King, unpublished), venation in the pupal wing is quite independent of tracheation; and the macrotrichia shown by Tillyard (1918) to be present on longitudinal veins and absent on crossveins in the Holometabola do not appear on the anal veins of beetles except at their extreme bases.

A possible interpretation of the 2a–3a crossvein in such configurations as 5, 6, 7, 8, and 9 is that it is lost by coalescence of 2A and 3A. However, in defense of the interpretation given here, Figs. 2 and 4 are particularly instructive. In these two figures the retention of all or part of 2A indicates that the vein in question is almost certainly a crossvein, and in these two figures it has assumed exactly the same position it occupies in those wings in which its nomenclature is in doubt. The same argument may be applied to crossvein 1a–2a if one considers the series 1, 2, 6, 9.

It is entirely possible that the steps which have been presented here as a sequence are in fact the result of parallelisms. One should not, on the basis of the evidence here, conclude that these genera represent a linear series. The point of interest is that these genera appear to have preserved, collectively, a reasonably complete picture of the venational changes that must have been made by the ancestors of the most specialized forms. The example presented here illustrates only one of the several paths taken by the anal veins of Coleoptera in the course of their many lines of specialization.

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NOTES ON THE BUPRESTIDAE: PART III[1]

By G. H. Nelson[2]

Additional distributional and host information of Buprestidae of the Southwest is made known in this paper, including new records for Baja California, and the female of *Trichinorhipis knulli* Barr is described. Thanks are due to Dr. John Roos for plant identifications and to the collectors mentioned in the paper for allowing the writer to make their collections known. Unless otherwise stated, the collections and observations were made by the writer.

The following four species are new records for Baja California and were collected by F. S. Truxal 4 mi. S.W. of La Zapopita, Valle de Trinidad, Apr. 16, 1961.

Acmaeodera jocosa Fall, 1899, J. N. Y. Ent. Soc. 7: 14.

A. quadriseriata Fall, 1899, J. N. Y. Ent. Soc. 7: 18.

A. dolorosa Fall, 1899, J. N. Y. Ent. Soc. 7: 25.

A. gemina Horn, Trans. Amer. Ent. Soc. 7: 23.

Acmaeodera aurora Fall, 1922, Bul. Brooklyn Ent. Soc. 17: 88. This species was taken by D. S. Verity, R. L. Westcott, K. T. Nelson and the writer in the San Jacinto Mountains above Palm Desert from 2,000 feet to 3,500 feet from June 13 to July 7—one specimen from *Juniperus californicus* Carr. and the others flying about the blossoms of *Acacia greggii* Gray.

Acmaeodera yumae Knull, 1937, Ohio J. Sci. 37: 301. This species was taken 65 mi. S. of Mexicali, Baja Calif., Mex., June 5, 1961, on *Ephedra sp.* by G. H. Nelson and H. F. Howden. This is a new record for Baja Calif.

Acmaeodera serena Fall, 1899, J. N. Y. Ent. Soc. 7: 16. One specimen was collected by the writer and H. F. Howden 10 mi. S. of Mexicali, Baja Calif., Mex., June 5, 1961, while sweeping roadside vegetation. This is the first known collection of this species from Baja Calif.

Acmaeodera hepburni LeConte, 1859, Amer. Phil. Soc. Trans. n.s. 11: 254. One specimen of this common species was cut from a dead limb of *Quercus dumosa* Nutt. one mile N. of Pinyon Flat Public Camp, San Jacinto Mountains, 4,000 feet elevation, Riverside Co., Calif., June 30, 1959, and others were taken by Peter H. Raven at Arroyo del Medio, Santa Cruz Island, Calif., April 25,

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[1] The second paper of this series was entitled "Notes on Buprestidae and Schizopodidae," Bul. Brooklyn Ent. Soc. 55(3): 70–74.

[2] Department of Anatomy, Loma Linda University, Loma Linda, California.

1960. Two specimens were taken by F. S. Truxal 4 mi. S.W. of La Zapopita, Valle de Trinidad, Baja Calif. del Norte, Mex., April 16, 1961. This is the first record for this species from Baja Calif.

Acmaeodera latiflava Fall, 1907, Canad. Ent. 39: 240. This species was taken near La Zapopita, Valle de Trinidad, Baja Calif. del Norte, Mex., Apr. 9–14, 1961 by F. S. Truxal. This is a new record for Baja Calif.

Acmaeodera nigrovittata VanDyke, 1934, Ent. News 45: 61. Numerous specimens were taken 8 mi. E. of Bakersfield, Calif. on blossoms of *Hemizonia kelloggii* Greene in a field of *Atriplex sp.* on various dates in April, 1961 by D. S. Verity, R. L. Westcott, the writer and his family.

Acmaeodera linsleyi VanDyke, 1943, Pan-Pac. Ent. 19(3) : 101. A single specimen of this species was reared from the dead limbs of *Quercus dumosa* Nutt. collected near Pinyon Flats Public Camp, San Jacinto Mountains, 4,000 feet elevation, Riverside Co., Calif. in June, 1959. The specimen was found dead in the rearing can on May 4, 1961.

Acmaeodera tenebricosa Fall, 1922, Bul. Brooklyn Ent. Soc. 17: 90. This species has been collected by beating *Fremontia californica* Torr. at the following places in Calif.: Wrightwood, San Gabriel Mountains, May 22 and June 7, 1954 and May 23, 1959 by the writer; Camp Baldy, San Gabriel Mountains, June 20, 1958 and Frazer Mt. Park, Kern Co., May 18, 1958 by D. S. Verity. It was reared by the writer from the same shrub with emergence dates as follows: May 20, May 26 and June 27, 1961.

Acmaeodera vermiculata Knull, 1947, Ohio J. Sci. 47: 174. Specimens were taken as they flew about bushes of *Dalea spinosa* Gray, 30 mi. N. of San Felipe, Baja Calif., June 4, 1961, by the writer and H. F. Howden. This species has not previously been recorded from Baja Calif.

Acmaeodera barri Cazier, 1940, Wasmann Collector 4: 58. A specimen was taken 30 mi. N. of San Felipe, Baja Calif., Mex. (new record from Baja Calif.), June 4, 1961, by the writer and H. F. Howden.

Acmaeodera palmarum Timberlake, 1939, Pan-Pac. Ent. 15: 181. This species was taken by D. S. Verity 10 mi. E. of Mesquite, Clark Co., Nev., June 2, 1960.

Acmaeoderoides humeralis Cazier, 1938, Bul. So. Calif. Acad. Sci. 38: 12. This species was described from two specimens collected at Amboy, San Bernardino Co., Calif. Three specimens were collected on *Eriogonum inflatum* Torr. & Frem., 16 mi. N. of Trona, Inyo Co., Calif., May 30, 1960, by R. L. Westcott.

Ancylotela barberi (Skinner), 1903, Ent. News 14: 238. One specimen was taken on *Olneya tesota* Gray, 80 mi. S. of Mexicali, Baja Calif., Mex. (new record for Baja Calif.) June 4, 1961, by the writer and H. F. Howden.

Ancylotela olneyae (Skinner), 1903, Ent. News 14: 236. A dead specimen was dug from a dead branch of *Olneya tesota* Gray, 80 mi. S. of Mexicali, Baja Calif., Mex., June 4, 1961, by the writer and H. F. Howden.

Hippomelas pacifica Chamberlin, 1938, J. N. Y. Ent. Soc. 46: 445–447. This species was described from four specimens, one labelled as coming from "sagebrush" at Kettleman, Kern Co., California. Messrs. D. S. Verity and R. L. Westcott's suspicions that the species could be found on *Atriplex* were borne out when they took a series from *A. polycarpa* (Torr.) 5 mi. S. of Kettleman City, Kings Co., Calif. on July 2, 1960. Additional specimens were taken by the writer and his family in the same area on the same plant, June 25, 1961.

Cinyra purpurascens Schaeffer, 1905, Bul. Brooklyn Inst. Mus. 1(6) : 127. Previously recorded only from Baja Calif., this species has been taken in the Palm Springs area of Southern California during June and July as it clings to the stems of *Beloperone californica* Benth. It has also been reared from the roots of this plant that were collected at Agua Caliente, San Diego Co., Calif.

Juniperella mirabilis Knull, 1947, Ohio J. Sci. 47(2) : 69. Collecting for this species during 1960 in the same area as in 1959 (Nelson, 1960 Bul. Brooklyn Ent. Soc. 55(3) : 72) revealed it to be extremely scarce. Only one *J. mirabilis* was seen for every 1200 juniper shrubs examined. Since the 1961 season was more dry than 1960, it was anticipated that the *Juniperella* population might be cut down still further. This was not the case, however, for their numbers rivaled that of the 1959 season.

Trichinorhipis knulli Barr, 1948, Ent. News 59(3) : 69–72. This species was described from a single male and until now the female has remained unknown. While beating *Acacia greggii* Gray near Jacumba, San Diego Co., Calif., one female was collected. When compared with the male type at the California Academy of Sciences, the differences were found to be similar to those between the sexes of the closely related genus, *Hesperorhipis*.

Description of female.—Form as male but differs as follows: head and pronotum slightly more narrow; antennae slender, fourth segment slightly dilated apically, serrate from fifth segment distalward, apical segment narrowed; elytra entirely covering abdomen; apices less convex than in male, consequently apical serrations more noticeable; ivory band of elytra extending from suture to lateral margin, beginning behind basal one fourth and covering second one fourth, band broadened toward lateral margin of elytra.

Length: 4 mm. Width: 1.6 mm.

Allotype, female (writer's collection), Calif., San Diego Co., 2 mi. E. of Jacumba, July 3, 1960.

Melanophila pini-edulis Burke, 1908, Proc. Ent. Soc. Wash. 9: 117–118. This species was recorded from California by Chamberlin (1917) from specimens thought to be a western form by E. C. VanDyke; however, Burke (1919) does not record it as occurring from California. There are no specimens of this species from California in the VanDyke collection, nor does the California Insect Survey list it as occurring in California. It is of interest then to report the capture of typical *M. pini-edulis* from the Pinyon Flat area of the San Jacinto Mountains in Southern California by R. L. Schultz and the writer. These beetles were found to be ovipositing in two live, but unhealthy, trees of *Pinus monophylla* (Torr. & Frem.) from June 12 to 15, 1960. Only one male was taken. Examination of these same trees during July failed to reveal any further specimens.

Actenodes calcarata (Chevrolat), 1835, Coleopt. du Mex. Cent 2, fasc. 5, No. 103. A single specimen, lacking head and pronotum, was dug from a dead branch of *Olneya tesota* Gray, 80 mi. S. of Mexicali, Baja Calif., Mex., June 4, 1961, by G. H. Nelson and H. F. Howden. This is the first reported occurrence of this genus from Baja Calif.

Actenodes arizonica Knull, 1927, Ent. News 38: 115. This species was collected on the limbs of *Prosopis chilensis* (Molina) below Madera Canyon in the Santa Rita Mountains, Ariz., Aug. 5–7, 1961, by the writer and his family.

Chrysobothris bacchari VanDyke, 1923, Bul. Brooklyn Ent. Soc. 18: 38. Previously known from Marin Co. and Santa Cruz Mountains in California, this species was taken at 2,000 feet in the San Jacinto Mountains, above Palm Desert, Calif., on *Baccharis sergiloides* Bray, June 28 and July 9, 1961. Thus, its range is extended southward several hundred miles.

Chrysobothris deserta Horn, 1886, Trans. Amer. Ent. Soc. 13: 99. This species was taken on *Atriplex polycarpa* (Torr.) 5 miles S. of Kettleman City, Kings Co., Calif., July 2, 1960, by D. S. Verity and R. L. Westcott and on June 25, 1961 by the writer and his family.

Chrysobothris biramosa callida Knull, 1958, Ohio J. Sci. 58: 96. One specimen was taken 10 mi. S. of Mexicali, Baja Calif., Mex., June 15, 1961, (new record for Baja Calif.) on *Atriplex lentiformis* Wats. by the writer and H. F. Howden.

Chrysobothris ulkei LeConte, 1859, Amer. Phil. Soc. Trans. (n.s.) 11: 240. This species, formerly considered rare, has been taken in numbers during the past several years near Portal, Arizona. One pair was taken by R. E. Ryckman at El Sueco, Chihuahua, Mexico, July 17, 1960, on *Ephedra sp.*

Chrysobothris parapiuta Knull, 1938, Ann. Ent. Soc. Amer. 31: 138. Two specimens were taken at Pinyon Flat, Riverside Co., California, June 15, 1960, as they were running on the branches of *Ceanothus perplexans* Trelease.

Chrysobothris smaragdula Fall, 1907, Canad. Ent. 39: 239–240. A large specimen (9 mm. in length) of what is evidently this species was taken on *Acacia greggii* Gray, June 23, 1957 at Snowcreek near Palm Springs, California, by R. L. Westcott. It was compared with the type by the writer and was found to differ slightly by having the pronotum more densely punctured and the legs having a rosy tint.

Agrilus chalcogaster VanDyke, 1946, Pan-Pac. Ent. 22(3): 81–89. This beautiful but rare species was described from a unique, so it is of interest to report the capture of two specimens—one by D. S. Verity at Mountain Springs, Imperial Co., California, June 4, 1957, as it flew to *Thamnosma montana* Torr. & Frem., and the other by the writer and H. F. Howden at the same place on June 7, 1961 as it was taking flight from *Gutierrezia californica* T. & G.

Agrilus illectus Fall, 1901, Calif. Acad. Sci., Occasional Papers, No. 8: 242. A fair series of this species was taken while sweeping *Lotus purshianus* Clem. & Clem. 5 mi. N. of Kernville, Kern Co., Calif., June 19, 1961.

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MOSQUITO CATCHES IN NEW JERSEY MOSQUITO TRAPS AND ULTRA-VIOLET LIGHT TRAPS[1]

By James E. Downey[2]

For many years the New Jersey mosquito trap has been used to survey and gain information on mosquitoes. It is of interest to note that while the New Jersey mosquito trap utilizes the standard 25-watt, tungsten-filament bulb as its attractant, Headlee (1937) found that blue light was the most attractive light for mosquitoes. Huffaker and Back (1943) state, "it would be hard to see why it is not wholly logical to expect that different species of mosquitoes will exhibit marked variations in their responses to light stimuli." The present investigation supports this view with additional specific evidence.

Light traps were used in 1961 as one method of measuring the effects of aerial applications of insecticides in forested areas on mosquito populations. Two kinds of light traps were operated in each of three areas located conveniently close to the University of Massachusetts at Amherst, but isolated from each other by at least two miles: (1) One standard New Jersey mosquito trap, described by Mulhern (1942), equipped with a 25-watt tungsten-filament bulb and suspended about six feet above the ground, was used in each area: (2) Two ultra-violet light traps of the design illustrated by Smith *et al.* (1959), equipped with 6-watt bulbs, were set on the ground in each area. The openings of the latter were covered with ¼ inch wire mesh to keep out large insects. At each trapping area one ultra-violet light trap was placed within a few feet of the New Jersey trap, and the other several hundred feet away. The traps were located in heavily wooded mixed stands and were not visible for more than a few hundred feet in any direction.

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[1] Contribution No. 42 of the Massachusetts Agricultural Experiment Station, Project 5129, and Contribution No. 1323 from the entomological laboratory of the University of Massachusetts. This investigation was supported in part by the Union Carbide Chemicals Co., New York, N.Y., and the Massachusetts Department of Natural Resources.

[2] Research Assistant, Department of Entomology and Plant Pathology, College of Agriculture, University of Massachusetts.

Although not all the mosquito catches were identified to genus and species, enough were examined to show differences between the catches in the different types of traps. Species of *Culex* (*restuans* Theo. and/or *pipiens* Linn.) and *Culiseta* [*melanura* (Coq.) and *morsitans* (Theo.)] occurred by the hundreds (267) in the New Jersey traps but did not occur, except for one specimen of *Culiseta morsitans,* in the ultra-violet light traps during the same period. On the other hand *Mansonia perturbans* (Wlk.) was captured about equally well by both types of traps. In the one area where the latter species appeared in numbers, the New Jersey trap caught 129 specimens; ultra-violet No. 1 caught 132 and ultra-violet No. 2 caught 139 specimens over the same period of time.

Aedes species also occurred in numbers in both types of traps. However, since this genus was the one reduced most by the spray program in the two treated areas and involved a number of species, each of which could easily react differently, no general statement on the relative efficiencies of the two types of traps for collecting *Aedes* seems justified.

It is well known that differences in design and location of traps affect the number and kinds of mosquitoes caught in them. Just what the effects were on the catches in this experiment cannot be completely evaluated. The New Jersey traps contained suction fans and 25-watt incandescent bulbs, as compared with the ultra-violet traps having no suction fan and only 6-watt bulbs. In spite of these advantages the New Jersey trap caught only about the same number of *M. perturbans* as each of the ultra-violet traps in the one area in which this species was present. This suggests that ultra-violet light may be more attractive to *M. perturbans* than the standard tungsten-incandescent bulb. Conversely, it seems quite clear that ultra-violet light is far less attractive, if attractive at all, to certain species of *Culex* and *Culiseta* than is the light produced by the tungsten-filament bulb. No other reasonable explanation is available for the tremendous disparity in numbers of specimens collected in the two types of traps.

ACKNOWLEDGMENTS

I wish to express my appreciation to Drs. J. F. Hanson, J. H. Lilly, E. H. Wheeler and E. I. Coher for their assistance in the preparation of this paper.

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NEW NAME COMBINATIONS AND NOTES ON SOME AFRICAN AND ASIAN SPECIES OF ALEYRODIDAE (HOMOPTERA)

By LOUISE M. RUSSELL [1]

This paper is presented for the purpose of making eight new name combinations available for use in determinations and publications. Pertinent information, including the hosts and localities from which the species were originally described, is given because it is not readily available elsewhere.

Acaudaleyrodes Takahashi

1951, Mem. de l'Institut Scien. de Madagascar, ser. A, fasc. 2, 6:382. Type-species, *Acaudaleyrodes pauliani* Takahashi, by original designation.

Five described species, two of which are already included, are assignable to this genus.

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[1] Entomology Research Division, Agric. Res. Serv., U.S.D.A., Washington, D.C.

Acaudaleyrodes africana (Dozier), Takahashi, 1951, Mem. de l'Institut Scien. de Madagascar, ser. A, fasc. 2, 6 :382.
Aleurotrachelus africanus Dozier, 1934, Ann. & Mag. Nat. Hist. 14 (ser. 10) : 190, illus. On *Desmodium* sp. Barumbu, Belgian Congo.

Acaudaleyrodes alhagi (Priesner and Hosny), new combination.
Aleurotrachelus alhagi Priesner and Hosny, 1934, Egypt Min. Agr. Tech. & Sci. Serv. Bul. (Ent. Ser.) 145: 9, illus. On *Acacia arabica* var. *nilotica, Alhagi maurorum, Prosopis stephaniana, Tephrosia apollinea.* Dakhla Oases, Kharga, Kom Ombo, Luxor-Karnak, Minya, Upper Egypt.

Acaudaleyrodes citri (Priesner and Hosny), new combination.
Aleurotrachelus citri Priesner and Hosny, 1934, Egypt Min. Agr. Tech. & Sci. Serv. Bul. (Ent. Ser.) 145: 7–8, illus. On *Citrus* spp., *Dodonaea viscosa, Lawsonia inermis, Psidium guajava, Punica granatum, Zizyphus spina christi.* Widespread in Egypt.

Acaudaleyrodes pauliani Takahashi, 1951, Mem. de l'Institut Scien. de Madagascar, ser. A, fasc. 2, 6: 382–384, illus. On "Mpanjakaben-tany." Maevatanana, Madagascar.

Acaudaleyrodes rachipora (Singh), new combination.
Aleurotrachelus rachipora Singh, 1931, India Dept. Agr. Mem., Ent. Ser. 12: 57–59, illus. On *Bauhinia* sp., *Cassia fistula, Dalbergia sissoo, Euphorbia pilulifera.* Dholi and Pusa (Bihar), Navsari (Baroda), India. Miani (Punjab), Pakistan.

Africaleurodes Dozier

1934, Ann. & Mag. Nat. Hist. 14 (ser. 10) : 187. Type-species, *Africaleurodes coffeacola* Dozier, by original designation.

Four described species are included in this genus.

Africaleurodes coffeacola Dozier, 1934, Ann. & Mag. Nat. Hist. 14 (ser. 10) : 187–188, illus. On *Coffea robusta.* Lodja, Belgian Congo.

Africaleurodes loganiaceae Dozier, 1934, Ann. & Mag. Nat. Hist. 14 (ser. 10) : 189, illus. On a plant of the Loganiaceae. Sankuru, Belgian Congo.

Africaleurodes ochnaceae Dozier, 1934, Ann. & Mag. Nat. Hist. 14 (ser. 10) : 188–189, illus. On *Ochna.* Kole (Lukenie River), Belgian Congo.

Africaleurodes vrijdaghii (Ghesquière), new combination.
Aleurolobus Vrijdaghii Ghesquière, 1934, Ann. de Gembloux, p. 30, illus. On coffee. Belgian Congo.

Dialeuropora Quaintance and Baker

1917, U. S. Nat. Mus. Proc. 51: 406, 434. Type-species, *Dialeurodes (Dialeuropora) decempuncta* Quaintance and Baker, by original designation.

In 1959 (Ent. Soc. Wash. Proc. 61(4): 185–186), I combined seven specific names with the generic name *Dialeuropora* in a list of the species belonging to this genus. Four names that were omitted from the previous list and one proposed since then are given below. This brings to 19 the total number of described species certainly assignable to *Dialeuropora*. A few other species, which cannot be placed from their descriptions, may belong here.

Dialeuropora bipunctata (Corbett), new combination.
Dialeurodes bipunctata Corbett, 1933, Stylops 2(6): 128–129, illus. On "Rengas," *Gluta* sp. Puchon, Malaya.
Dialeuropora dothioensis (Dumbleton), new combination.
Dialeurodes (Dialeuropora) dothioensis Dumbleton, 1961, Pacific Science 15: 121–122, illus. On undetermined host. Dothio River Bridge, New Caledonia.
Dialeuropora indochinensis Takahashi, 1942, Nat. Hist. Soc. Formosa, Trans. 32: 272–273, illus. On undetermined host. Angkor, Cambodia.
Dialeuropora malayensis (Corbett), new combination.
Trialeurodes malayensis Corbett, 1935, Fed. Malay States Mus. Jour. 17: 812–813, illus. On unidentified host. Rembau (Negri Sembilan), Malaya.
Dialeuropora silvarum (Corbett), new combination.
Trialeurodes silvarum Corbett, 1935, Fed. Malay States Mus. Jour. 17: 813–814, illus. On unidentified host. Kuala Lumpur (Selangor), Malaya.

A NEW NEARCTIC *TABANUS* OF THE *FULVULUS* GROUP

By L. L. Pechuman[1]

In the Cooperative Economic Insect Report of June 2, 1961 (Vol. 11, No. 22), page 463, Cancienne and Newsom report *Tabanus longiusculus* Hine from Louisiana. Since the writer has seen *longiusculus* only from North Carolina, South Carolina, Georgia, Florida and Tennessee, this was thought to be an interesting extension of range.

Through the cooperation of Mr. Bobby H. Wilson of Louisiana State University a series of specimens reported as *longiusculus* was made available for study. It was found that these specimens differed from *longiusculus* in having a broader abdomen, narrower front, dark hind femora, a linear median callus and less distinct thoracic stripes. The characters of these specimens related them to *Tabanus fulvulus* Wied. However, they appear to be distinct from *fulvulus* and apparently represent an undescribed species. Other specimens have since been located in the collections of Ohio State University, C. B. Philip and the writer.

A specimen from Arkansas in the writer's collection has been selected as the holotype since a male collected at the same time makes an appropriate allotype. It is a pleasure to dedicate this species to Mr. Wilson who not only supplied a series of the new form, but also located other specimens pertinent to this study as noted below.

Tabanus wilsoni, n. sp.

Holotype, female, 13.5 mm. Eye bare. Front narrow, about six times as high as width at base, slightly widened above; basal callus very dark brown, almost twice as high as wide, very narrowly separated from eyes; median callus linear, not reaching basal callus; front golden brown pollinose with black hairs; no ocellar tubercle. Subcallus and upper portion of genae golden brown pollinose, shading below on genae to white; genae black and yellow haired above, long white haired below. First and second antennal segments orange with black hairs; basal plate of third antennal segment orange, rather broad, about two-thirds as broad as high, with a distinct dorsal angle and moderate dorsal excision; annulate portion black, distinctly shorter than basal plate. Second palpal segment

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[1] Cornell University, Ithaca, New York.

cream colored, rather stout near base but tapering to an acute point, mostly black haired with a few white hairs near base and below; first palpal segment long white haired.

Mesonotum dark brown, paler along lateral margins and on prescutal lobe; the usual three longitudinal stripes obsolete except center stripe which is fairly distinct but extremely narrow. Mesonotum with short white and black hairs; prescutal lobe with longer black hairs. Scutellum concolorous with mesonotum. Pleurae gray with white hairs. Wing, including costal cell, hyaline with a faint yellowish tinge; veination normal. Coxae and femora black; most of apical half of middle femora yellow brown; apex of fore and hind femora yellow brown; tibiae yellowish, fore tibiae becoming gradually darker on apical half giving an indistinctly bicolored appearance; hind tibial fringe predominantly black with a few pale hairs intermixed; tarsi dark brown, middle and hind metatarsi paler at base.

Abdomen dark brown with three rows of yellow brown spots on first six tergites; median row, from second segment on, composed of contiguous triangles which are pale haired; pale triangle on second tergite outlined anteriorly by a dark dash on each side; the sublateral rows are composed of roundish spots which on the first three segments occupy most of width of tergite. Venter yellowish with a faint dark central spot on first two tergites; mostly pale haired.

Arkansas River, Arkansas Co., Arkansas, 8 June 1956.

Allotype, male, 13.5 mm. Similar to female. Eye bare; large facets not much larger than small facets but area sharply differentiated and occupying about half of eye area. Antennae colored as in female but basal plate of third segment narrower. Second palpal segment cream colored, blunt, slightly more than twice as long as thick, black and yellow haired. Mesonotum dark brown with a median stripe vaguely indicated, black haired with a few pale hairs; scutellum dark brown; prescutal lobe reddish brown; pleurae gray with pale yellow hairs. Legs as in female. Abdominal markings much like female; median pale triangle on second tergite truncated above by a dark spot. Same data as holotype.

Paratypes: Arkansas: same data as holotype, 1 ♂. *Louisiana:* Mound, 29 June 1922 (W. G. Bradley), "feeding on horse," 1 ♀; Baton Rouge, 1922, 1 ♀; 4 June 1923 (W. G. Bradley), "feeding on horse," 1 ♀; St. Landry Parish, 20 May 1959, 2 ♀♀; 25 May 1959, 1 ♀; 27 May 1959, 11 ♀♀; 1 June 1959, 4 ♀♀; 22 June 1959, 1 ♀ (B. H. Wilson); Tensas Parish, 25 May 1959, 3 ♀♀; 23 June 1959, 1 ♀ (B. H. Wilson); New Roads, 14–18 July 1905, 5 ♀♀.

Holotype and allotype in writer's collection. Paratypes in collections of Louisiana State University, Ohio State University, Cornell University, U. S. National Museum and C. B. Philip.

The holotype, allotype and topotypic male paratype were collected by Dr. H. E. Evans as prey of the wasp *Bembix pruinosa* Fox. These three specimens were reported by Evans (1957, p. 159) as *Tabanus fulvulus*.

Variations: There is little variation in the series of paratypes studied except in size. The smallest specimens are 11 mm. and the largest is 14.5 mm. in length. Most specimens are somewhat smaller than the holotype. In some specimens the sides of the front are parallel. A male paratype collected at the same time as the allotype shows more yellow hairs on the pleurae than the allotype. Some specimens collected in 1905 are rather pale but this is believed due to age; the basal callus of some of these is dark yellow.

Comparative Notes: Both sexes of *T. wilsoni* may be separated from *T. fulvulus* by the generally brownish color in contrast to the yellow appearance of *fulvulus*. In detail, the black haired palpi and black hind tibial fringe of *wilsoni*, with the lack of yellow hairs on the mesonotum and pleurae and less distinctly bicolored fore tibiae makes differentiation from *fulvulus* relatively easy. Northern females of *fulvulus* sometimes have many black hairs on the palpi and northern males may have mostly black hind tibial fringes but the orange thoracic pilosity readily distinguishes these from *wilsoni*.

Specimens of *wilsoni* and *fulvulus* placed in a moist chamber to restore eye color indicate the eye pattern of *wilsoni* to be three purple bands on a blue green background; the specimens of *fulvulus* showed three similar bands on a bright green background.

Philip (1936) described *pallidescens* as a variety of *fulvulus*. The writer believes the characters given by Philip are sufficient to separate *pallidescens* at the specific level since they are consistant in the rather adequate series studied. A series of *fulvulus* and *pallidescens* collected by A. and H. Dietrich at Marianna, Florida on June 5 and 6, 1961 show an additional character supporting the distinctness of the two forms. In *fulvulus*, the eye in life is bright green with three purple stripes; in *pallidescens* the eye is bronzy green with one purple stripe. This difference has been confirmed by placing specimens from various localities in a moist chamber. It is interesting to note in this connection that the three eye stripes of *T. fulvulus* restore easily, whereas the single stripe of *pallidescens* requires a longer period of moistening to appear and in some specimens no stripe could be restored.

The range of *fulvulus* and *pallidescens* is similar; *fulvulus* has been collected further north than *pallidescens,* and *pallidescens* apparently ranges a little further toward the southwest.

T. wilsoni is separated from *pallidescens* by the dark annulate portion of the third antennal segment, dark femora and generally darker color.

Hine (1907, p. 49) reports *T. fulvulus* from Baton Rouge, New Roads, Keachie and Crowley, Louisiana. Later (1914, p. 227), Hine discussed *fulvulus* under four different forms. Forms 1 and 2 seem to be within the variation associated with *fulvulus;* Hine reports none of these from Louisiana. Form 3 is listed only from New Roads, Louisiana. Form 4 he records from Louisiana and Georgia.

Through the kindness of Prof. J. N. Knull of Ohio State University, the writer was able to study a series of Hine's *fulvulus* collected at New Roads, Louisiana, 14–18 July 1905; all of these are *T. wilsoni.* All other Louisiana specimens in the Hine collection seen by the writer are *T. pallidescens.*

Jones and Bradley (1923) reported *T. longiusculus* from Mound, Louisiana on a basis of a determination by Dr. J. M. Aldrich. They also report the presence of *T. fulvulus* in May and record the collection and rearing to adult of a *T. fulvulus* larva collected in a well rotted log near Baton Rouge. The same workers (1924) again list *T. longiusculus* from Louisiana and report *T. fulvulus* as present during May, June and July with the period of greatest abundance in May.

Mr. Wilson was able to locate in the Louisiana State University collection a single specimen collected by Bradley at Mound, Louisiana, 29 June 1922, and determined by Aldrich as *T. longiusculus.* This specimen is *T. wilsoni.* A second specimen collected by Bradley on 4 June 1923 at Baton Rouge also is *wilsoni;* both specimens are noted as "feeding on horse." Mr. Wilson also sent me a series of six specimens determined as *fulvulus* and collected by Jones and Bradley. All are from Magnolia, Louisiana, 16 May 1922 and 11 June and 12 July 1923, and are noted as "feeding on mule." All six specimens are *T. pallidescens* Philip.

From the above it seems apparent that Hine's *fulvulus* from Louisiana is composed of both *T. wilsoni* (Form 3) and *T. pallidescens* (Form 4). *T. longiusculus* of Jones and Bradley is *T. wilsoni* and their *fulvulus* is *pallidescens.*

T. fulvulus has not been seen by the writer from Louisiana except for a series collected by B. H. Wilson, St. Helena Parish, 30 May 1962. In addition, *fulvulus* has been seen during this study from New York (Long Island), New Jersey, Pennsylvania, Ohio, Illinois, Kentucky, Tennessee, Missouri, Arkansas, Maryland, D.C., Delaware, Virginia, North Carolina, South Carolina, Georgia, Florida and Alabama. *T. pallidescens* has been seen from Maryland, Tennessee, Missouri, Arkansas, North Carolina, Georgia, Florida, Alabama, Mississippi and Louisiana.

KEY TO TABANUS RELATED TO FULVULUS

1. Third antennal segment entirely orange; legs pale; eye of female in life with a single purple band. Large eye facets of male considerably larger than small facets and occupying about ⅔ of eye area . . . . *pallidescens* Philip

   Annulate portion of third antennal segment black; femora mostly dark; eye in life with three purple bands. Large eye facets of male not much larger than small facets and occupying about half of eye area 2

2. Mesonotum orange or yellow haired; hind tibial fringe usually mostly orange; palpi usually mostly pale haired; pleurae with orange hair . . . . *fulvulus* Wied.

   Mesonotum white and black haired; hind tibial fringe mostly black; palpi mostly black haired; pleurae with pale hair *wilsoni*, n. sp.

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POSSIBLE WASP MIMICRY BY ONCOPOELTUS GUTTA H. S. (LYGAEIDAE)

By Joseph C. Schaffner
Iowa State University

On July 23, 1959, while collecting five miles north of Mazatlan, Sinaloa, Mexico, I observed four specimens of *Oncopeltus gutta* that upon disturbance exhibited a behavior pattern highly suggestive of that of certain wasps of the family Pompilidae. The behavior was characterized by swift jerky running movements carried on simultaneously with rapid vibration of the wings which were held high over the body. Both males and females were observed acting in this manner. Two of the four specimens took flight. A fifth specimen was also collected that did not show the above behavior.

Mimicry of this type apparently has not been reported in the literature for members of the Lygaeidae. The bright coloration of many members of the subfamily Lygaeinae to which *Oncopeltus gutta* H. S. belongs has been presumed to be warning in nature and associated with the Asclepiadaceae upon which many species feed.

The abdominal color pattern of this species might possibly be construed to be a supplementary character for this possible mimicry. The posterior three pregenital segments of the abdomen are dark red in contrast to the preceding abdominal segments which are yellowish-orange on these specimens. This color pattern might suggest the abdomen of an aculeate wasp.

New distributional and host record for *Poecilothrips albopictus* Uzel. The recorded distribution of the tubuliferous thrips *Poecilothrips albopictus* Uzel is of a discontinuous nature. It is known from California, Western Washington, New Jersey, Pennsylvania, and the District of Columbia. On April 25, 1961, R. E. Stecker collected specimens of this thrips emerging from a dead sumac branch (*Rhus glabra*), approximately five miles northeast of Lewiston, Nez Perce County, Idaho. According to available literature sumac has not been listed as a host for this thrips. This, therefore, establishes a new distributional and host record for this species of insect.—Richard B. Roberts, University of Idaho.

FILING AND STORING LIQUID-PRESERVED INSECTS[1]

By John F. Hanson

The recent appearance of publications describing new tray designs (Evans, 1958, and Killough, 1959) for the storage of vials of liquid-preserved specimens prompts me to words on the same subject. Certainly a great deal of attention should be focused on this subject since some of our more common storage systems are not only unsatisfactory but can be quite annoying and cumbersome. One of the reasons for this situation is that when a collection is small, it doesn't much matter what system is used. Thus, the initial design of many collections is almost accidental, depending on what containers and materials happen to be most conveniently and cheaply available. Unfortunately, as a collection grows, some of its features often become more and more objectionable. By the time a collection is large enough for its objectionable features to become conspicuous, one is usually too deeply committed, financially and otherwise, to change it. Therefore, the selection of a system of filing alcoholic specimens is usually a much more important decision than is realized in the initial stages of gathering a collection.

The major types of trays or containers for holding vials are the following: pint preserving jar holding inverted specimen vials in a reservoir of liquid, cigar box or the like, vertical screen with vials hung on wire hooks (Needham system), double-row compartmentalized tray, double-row noncompartmentalized tray (Fig. 2), compartmentalized and noncompartmentalized single-row trays. The author has been using a double-row noncompartmentalized tray system with quite satisfactory results for over twenty years. This was adopted for The University of Massachusetts collection many years ago and has been serving satisfactorily. The essential features which make this system feasible and desirable are shown in the figures and discussed in the text.

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[1] Contribution No. 55 of The Massachusetts Agricultural Experiment Station and Contribution No. 1353 from the entomological laboratory of The University of Massachusetts. Supported by NIH Grant E-1442 (C6), U. S. Public Health Service.

HANSON

PLATE I

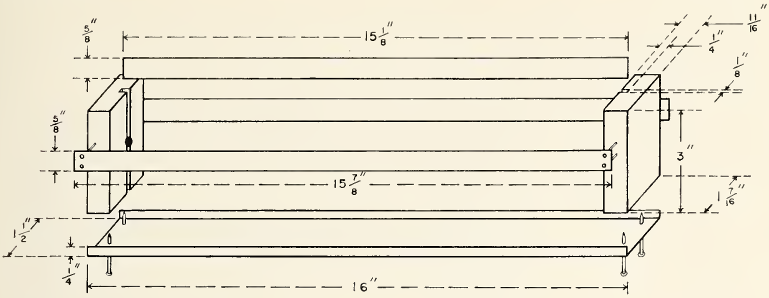

Fig. 1, Exploded view of double-row noncompartmentalized tray showing dimensions of tray for two dram homeopathic vials. Twenty-two gauge galvanized steel provides adequate rigidity.

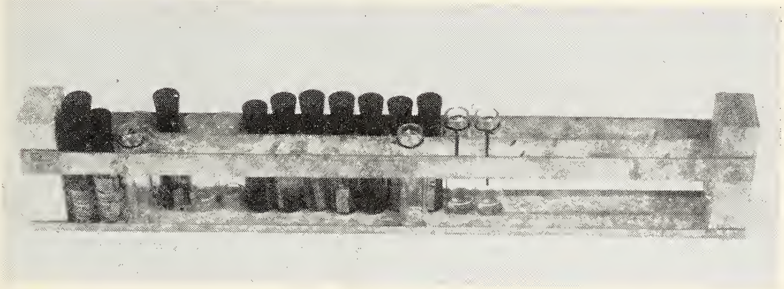

Fig. 2, Assembled tray showing compactness of storage and use of the guard vials (see Fig. 4) hung over the center strip to hold specimen vials in place in trays in which expansion room is desired.

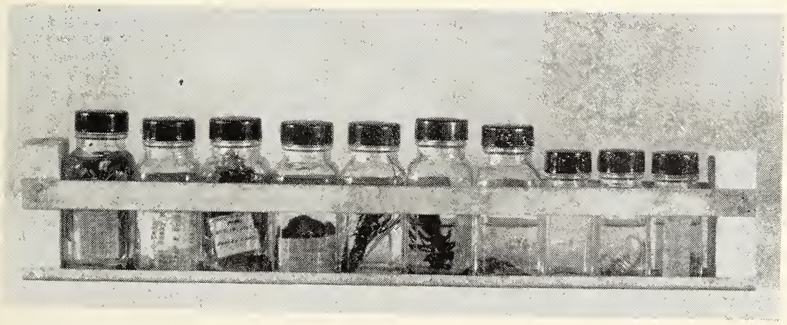

Fig. 3, Tray with removable center strip taken out to permit storage of two sizes of square bottles containing large specimens.

HANSON PLATE II

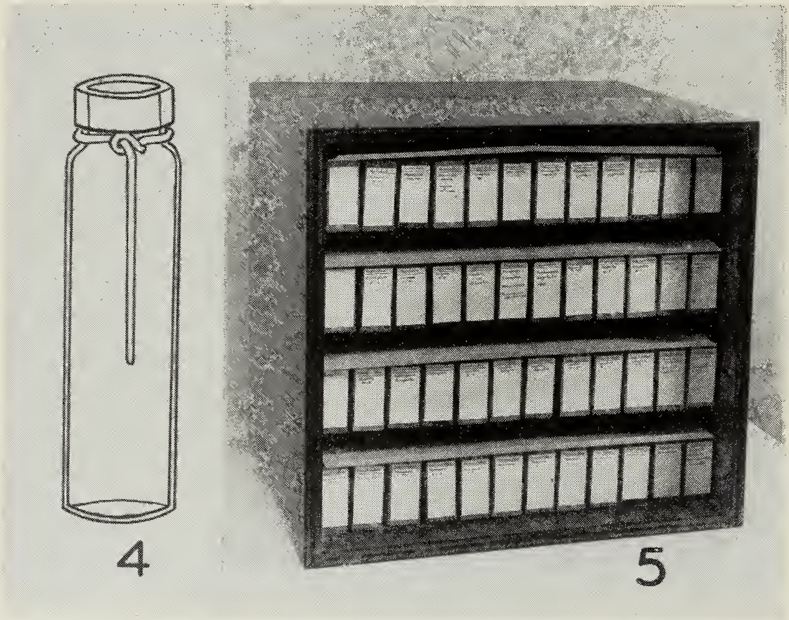

Fig. 4, Guard vial showing details of wire attachment around neck of homeopathic vial. Fig. 5, Cabinet and trays. Note the manilla filing folders used as dust and light covers above each row of trays: the opened folder is thumbtacked at the rear of the undersurface of each shelf and the front edge lies on the ends of the trays. The front edge is bent up slightly so as not to catch on trays being moved in or out of the cabinet.

ASSEMBLY PROCEDURE

The assembly of the tray described above can be very simply executed. First, preferably with a power drill, without any fussy measuring, make appropriately sized holes through the metal side pieces: the holes can be bored through a considerable number of pieces at a time by clamping a group of them in a vice. Then, "by eye", drive a carpet tack in the center of the groove of each wooden end block: the tacks become the supports for the center strip. Put the end blocks in a rough wooden jig which will hold the blocks upright at their proper spacing, and then position the bottom channel over the ends of the blocks. With a point punch make the nail holes to fasten the above pieces together, driving the punch through the metal and slightly into the wood. It is important to make these holes in this manner so as to create a slight recess in the bottom channel for each nail head: this prevents the nail head from catching and scratching on the shelves of the cabinet. After fastening the bottom channel to the end blocks with No. 12 gauge wire nails, remove the assembly from the jig and drop the divider strip into the slots. After it is made to fit snugly by pressing in or out against the free ends of the wooden blocks, lay on a side strip, line it up with the center strip by eye, and nail it on with No. 17 gauge wire nails. Do the same with the other side piece and the job is complete.

Critical Comparisons

It is not possible to design a system which is satisfactory from all points of view because financial circumstances, size variations within the group being preserved, etc., provide each collection with individual characteristics and problems that make special compromises necessary. However, it is possible to effect compromises producing less objectionable situations than exist in many major collections of the world. Thus, it seems to me, it is not enough simply to extol the merits of still another device: it is more important to evaluate critically the significant factors of the different systems of storing collections, with special emphasis on the pitfalls so that our mistakes and inefficiencies will not be perpetuated and expanded. Such a critical review follows.

1. Compactness

Perhaps the least compact of all systems is the one developed by Needham at Cornell. In the Needham system each specimen vial is "wired" (Fig. 4) so as to provide a hook by which the vials can be hung on vertically oriented screens about the size of a window screen but with a much coarser mesh. The vials must be quite widely spaced in order to maintain organized rows and the screens must be rather widely separated in their cabinets to prevent the vials from bumping each other as the screens are moved in or out.

A series of preserving jars offers more compact storage, but still there is considerable lost space above the vials within the jar, between jars, and above the jars to provide access to jars located to the rear of the shelf.

Of the tray-type filing systems, the noncompartmentalized type with the vials touching each other is obviously the most conservative of space. The double-row tray is more conservative of space than the single-row tray. Trays with metal side pieces are more conservative than those with the thicker wooden side pieces. For example, in my cabinets only one and a quarter inches of the width of the cabinet is consumed by the 36 strips of metal required for the twelve double-row trays on each shelf: over 2,000 two dram vials can be stored in the cabinet shown in Figure 5. No other system affords as much efficiency of space usage.

2. Safety of Specimens

One of the reasons for rare usage of the noncompartmentalized tray, in spite of its compactness and other advantages, has been the difficulty of keeping the vials securely in place. Some workers have used a book end type of device (the sheet metal type with a section extending under the books as well as up along the side of the end book). This, however, is quite unsatisfactory because the weight of the small vials is hardly sufficient to hold the stop in place under normal tray usage, and is wholly inadequate in cases where there are only a very few vials in a row. Nonetheless, with the proper devices and reasonable care, there is virtually no chance of vials slipping out of the noncompartmentalized trays.

The proper device was practically thrust upon me while I was studying the Needham collection at Cornell where each specimen vial is "wired", as previously mentioned. I discovered that these wired vials cling very nicely to the sharp edges of the metal divider strip of the double-row noncompartmentalized tray, and therefore, can be used as guard vials to hold rows of specimen vials in place in unfilled trays: one or two guard vials hung on the center strip at the end of the row of vials suffice (Fig. 2). If only one of the rows of the tray is in use, two spaced guard vials in the unused row keeps the center strip from bending under the weight of the vials, and only an abnormal amount of shaking and tipping of the tray will dislodge any of the vials. I can not remember more than twice in the past ten years when a vial has slipped out of a tray, and in both cases gross carelessness was involved.

The double-row tray is much to be preferred over the single-row tray because it is much less likely to be accidentally overturned. The tipping hazard of the double-row tray is further reduced since, for a given number of vials, one needs on his desk only half the number of trays that would be required if single-row trays were used.

Killough has described an interesting type of wooden double-row tray from which the vials can not easily fall even if the tray is tipped over or roughly jarred. For this reason, Killough's design has distinct advantages for field work, especially since double-row may be built upon double row into one easily carried large capacity field kit, as he has described. However, for laboratory usage, the tray system described herein has distinct advantages with regard to accessibility of specimens, general handling ease, and adaptability for different vial or bottle sizes.

Evaporation of the preservative liquid and the resultant drying out and shriveling of valuable specimens has been a very serious problem with all open systems of storing specimen vials. Cork stoppers vary considerably in their permeability, and, as a result, liquids often evaporate much faster from one vial than from another. This is the main reason why the use of preserving jars was instituted, in spite of their disadvantages. Inverting specimen vials in a reservoir of fluid in a preserving jar insures that no evaporation can occur from the vials.

In recent years the availability of neoprene stoppers—which are nearly impervious to gases, are more uniform than cork stoppers, and do not swell on contact with some liquids as does natural rubber—has made relatively safe the open storage of small specimen vials. Nonetheless, it is wise to put a tablespoonful or two of glycerine in each stock gallon of preservative to insure against complete drying out of specimens. Then, if a stopper is carelessly installed or accidentally loosened, there will still be a very thin film of glycerine on the bottom of the vial to prevent total drying and shriveling of the specimen. I find that it is necessary to spend only a few hours about every five years to check for evaporation losses.

3. Filing and Handling Ease

Accessibility of particular specimens is certainly the poorest in bulk storage systems, such as the preserving jar, where the vials must be removed and replaced one by one in order to read the labels. Further, if the cabinet or shelf on which the jars are kept is deep enough for efficient storage, jars become hidden behind one another and are mixed up in the shuffle of finding particular specimens. In the Needham system, unless the rows of vials are kept quite widely separated, special care is required to be sure that the end of the wire hook of every specimen vial goes through the proper hole in the screen in order to maintain a reasonable semblance of rows. Also, it is difficult to find a place to stand the screen racks safely even if you are lucky enough to have a desk near a wall against which to lean the rack: and then everything behind the screen is inaccessible because of the breadth and height of it.

It is often argued that the single-row tray is the best because there is no obstruction to the view from either side. However, even with the single-row tray, one is inclined to orient the labels on one side only so as not to have to twist the tray back and forth to read labels. Therefore, the single-row tray has no visibility advantage over the double-row tray, which has an obvious price and stability advantage over the single-row tray. In the compartmentalized tray, the precise placing of a particular vial often requires a process of first moving a dozen others to new positions, one by one. The simplest tray in which to file specimens is the open-top noncompartmentalized tray with guard vials (Fig. 2). To add one or several specimen vials, simply move the guard vials a little and push the appropriate specimen vials along to make room to drop in the additions. For field usage Killough's multiple double-row rack is better because the vials are more securely held in place, but this security is accomplished at some sacrifice in accessibility of vials.

No matter what sort of tray is used, the storage cabinet should have removable shelves so that the trays need not necessarily be handled individually. Also, the cabinets with contents (Fig. 5) should be no larger than can be easily moved about by two weak biologists.

4. Adaptability

The preserving jar system and the Needham system have the advantage of accepting a variety of vial sizes, but the tray systems, having many more advantages, are much more desirable. The compartmentalized row-type tray has an advantage over the noncompartmentalized tray in its ability to accept vials of different sizes side by side. However, this is of little importance since with most groups of insects it is possible to select one small vial size that will be convenient for all specimens. For instance, in the Plecoptera, one vial size is sufficient: there are no species too large to fit into a two dram vial. And a smaller vial would not be appropriate even for the tiny specimens anyway, since the two dram vial is the smallest homepathic vial into which tweezers can be inserted to the bottom without having to squeeze them closed to get them through the mouth of the vial. For another reason also, the two dram vial is the smallest convenient size: it is not possible to insert adequate data easily into a smaller vial, especially if a typed label is used. I have found a portable typewriter with small type extremely useful not only for reliable legibility of the finished label but for preparation of labels while the wife is driving from one collecting station to another, thus saving literally hours each day.

For taxonomic groups with great size variations it may not always be convenient or economical to standardize on one size of vial, but it is still practical to use the noncompartmentalized tray system. Genera with larger or smaller species than the average size for the group concerned can be properly filed amongst the others by appropriately interspersing a few trays of different size. Furthermore, even if only one tray size is used, adaptability to groups with large species is possible simply by lifting out the removable center strip of the tray so that the whole width of the tray can be used to accommodate large square bottles in a single row (Fig. 3).

5. Cost of Cabinets and Trays

Parts and labor for one cabinet and its 48 trays for two dram vials, as described in this article (Fig. 5), is less than fifty dollars. Since 2,000 vials can be stored in such a cabinet, the prorated cost per vial is one and a half cents.

The cost of each tray (Fig. 1), holding 44 vials, is no more than 65 cents (50 cents for parts and 15 cents for labor). The compartmentalized tray constitutes more expensive storage not only because it separates the vials one from another in each row but because the compartmentalized tray is more expensive to make. For example, the ingeniously simple single-row tray described by Evans (1958) stores only 18 vials compared to 22 in each row of the tray described here, even though his tray is longer and the vials he uses are smaller. At a cost of 45 cents per tray his cost per vial for the tray alone is over two cents. Since his system must also require a larger cabinet for any given number of vials, his total storage cost per vial can safely be estimated to be nearly twice that of the cost of my system. Only the cigar box and the preserving jar offer a cheaper unit storage cost, but both are quite undesirable because of poor accessibility of specimens, poor visibility of labels, and handling and filing difficulties.

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NOTES ON BANKS' SPECIES OF PELTOPERLIDAE (PLECOPTERA)

By Stephen W. Hitchcock[1]

Recently I have had the opportunity to examine and make freehand sketches of some of Nathan Banks' type specimens of Peltoperlidae at the Museum of Comparative Zoology at Cambridge, Massachusetts. The lack of certain details and illustrations in the original descriptions has made it difficult for workers in Southeast Asia or the western United States to identify these members of their fauna. It is hoped that these notes might help to clear up some of the confusion on these species, the types of which are located half a world away from the home range of the insects.

Peltoperla nigrisoma Banks 1948. The holotype male is labelled as M.C.Z. type 27724 and comes from Sequoia Park, California. Jewett (1956) surmised that this species was synonymous with *Peltoperla brevis* Banks and examination of the type shows that this is indeed so. It does not differ from California specimens of *brevis* except for being slightly darker in color. It agrees with almost all California specimens of *brevis* examined to date in having veins M and Cu_1 of the hindwing joined together for a short distance. *P. brevis* was originally described from British Columbia and specimens of *brevis* from the Pacific Northwest including a paratype from Port Renfrew, B. C., do not show this peculiarity of venation. The illustration in Needham and Claassen (1925) of the hind wing of *P. brevis* was thus obviously from a California specimen and is not typical of specimens from the area where the

Explanation of Plate

Fig. 1, *Peltoperla mindanensis* Banks. Fig. 1 a, forewing. Fig. 1 b, ventral view ninth abdominal segment. Fig. 1 c, lateral view of vesicle. Fig. 1 d, proximal cercal segments. Fig. 2, *Peltoperla concolor* Banks. Fig. 2 a, forewing. Fig. 2 b, ventral view ninth abdominal segment. Fig. 2 c, proximal cercal segments. Fig. 3, *Neopeltoperla chiangi* (Banks). Fig. 3 a, forewing. Fig. 3 b, ventral view abdominal segments. Fig. 3 c, proximal cercal segments. Fig. 3 d, cercal spur of paratype Fig. 3 e, cercal spur of holotype in U. S. N. M. (O.S.F. Jr.). Fig. 4, *Neopeltoperla fraterna* (Banks). Fig. 4 a, forewing. Fig. 4 b, ventral view, ninth abdominal segment. Fig. 4 c, cercal spur.

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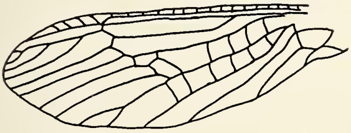
[1] The Connecticut Agricultural Experiment Station, New Haven.

HITCHCOCK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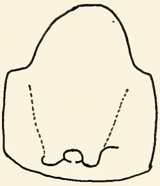
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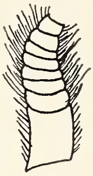
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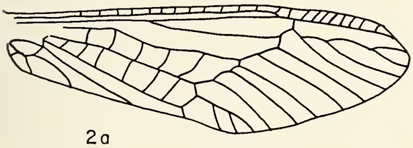
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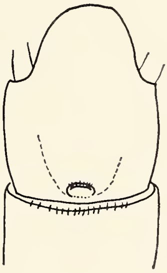
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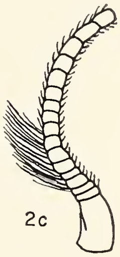
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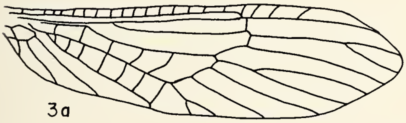
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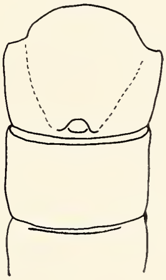
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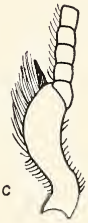
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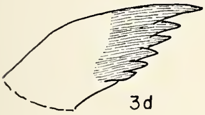
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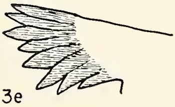
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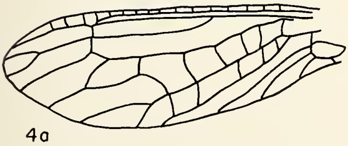
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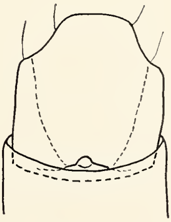
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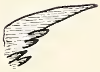
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type was taken.

Peltoperla mindanensis Banks 1924. There are two specimens labelled with type number "MCZ 14806." Both bear the data "Surigao, Mindanao, Baker" and carry the additional number "16325." As one specimen has the abdomen missing, I am denoting the other as the holotype. The abdomen of this specimen has been relaxed and examined (Fig. 1 b). The vesicle of the holotype male is somewhat smaller than the specimen illustrated by Jewett (1958). The ventral portion of the vesicle is glabrous but its dorsal half bears a few light hairs. The cercal segments (Fig 1 d) are strongly haired but with no particular pattern. Forewing venation is shown in Figure 1 a.

Peltoperla concolor Banks 1931. There are three insects in the type series labelled as type 16490. Banks implied that males from 7200 feet on Mt. Kinabalu, Borneo, represented the type. Although none were located with these exact data, two males from 7000 feet were in the type series and so I designate the specimen collected "28:3:1929" as the type specimen. The wings (Fig. 2 a) are notable by the large number of forkings and the number of costal crosveins beyond the end of the subcosta. The abdomen was relaxed and examined (Fig. 2 b). The ninth segment bears a small vesicle. Near the distal margin of the vesicle there is a dark line and a few dark hairs. Just before the ventral hind margin of abdominal segments 5–8 there is an irregular row of darker longer bristles. These bristles are progressively longer and darker as one moves from segment 5 to 8. The cerci (Fig. 2 c) are many segmented, but with a large basal segment, and bear a brush of long hairs on the inner margins of some of the proximal cercal segments. The paratypic male from 7000 feet has broken cerci but there is an indication that it too had the same brush of hair on the inner cercal margin. The specimen in the original type series from 3000 feet does not have this brush of hairs but has the cerci evenly haired except for a single long seta extending ventrally from each segment.

Neopeltoperla chiangi (Banks) 1940. A male paratype in the M.C.Z. from Mu Sang Tsai was relaxed and placed in alcohol. The wing venation (Fig. 3 a) appears like that described by Banks. The ventral ninth segment has a small vesicle (Fig. 3 b). On the posterior ventral margin of most of the abdominal segments there is a closely set row of small dark spinules that superficially appears like a black line. The basal segment of the cercus is the longest (Fig. 3 c). It bears a prominent spur that is shorter than the brush of hair found on the same segment. The cercal spur (Fig. 3 d) bears several teeth of decreasing size.

At my request, Dr. Oliver S. Flint, Jr., of the United States National Museum cleared and examined the male type of *N. chiangi* at that institution and stated that it agrees quite closely with my figures of the abdomen and appendages of the paratype. Minor differences are that the cercus of the holotype is straighter apically than that shown in Figure 3 c and the teeth on the spur are as Figure 3 e. This difference in the shape and number of teeth is considered to be within the range of variation of the species. The holotype was collected from Liu Ngai Si.

Neopeltoperla fraterna (Banks) 1938. A single male bearing MCZ type number 22698 from Pahang, Malaya, was examined. Banks (1940) stated that *N. fraterna* does not bear "a small rounded piece at base of penultimate ventral segment." The male type however bears a definite vesicle on the ninth ventral segment (Fig. 4 b). The hairs associated on the basal segment with the cercal spur are shorter than the spur. Thus spur is longer than that on *N. chiangi* and bears one long tooth and four shorter blunter teeth near its base (Fig. 4 c). An unidentified male stonefly in alcohol from Pahang in October in the M. C. Z. was examined and also proved to be this species.

.*Cryptoperla divergens* Banks 1914. The type specimen of this species is not to be found at the Museum of Comparative Zoology nor the U. S. National Museum.

Peltoperla formosana Klapalek 1913. Two female *Peltoperla* from Formosa in June and October, identified by Banks as this species, do not appear inconsistent with Klapalek's original description. The female subgenital plate is slightly more rounded than the type figured by Klapalek. There are 26–28 cercal segments, all of the same approximate size.

I should like to express my appreciation to the staff of the M.C.Z. for the use of their time and facilities. This study was supported by a Grant-inAid from the Society of Sigma Xi.

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Ecology of Inland Waters and Estuaries, by G. K. Reid. A Reinhold College Textbook, 392 pp., 112 figs. 1961. The author discusses the contributions of geology, chemistry, biology, physics and hydrology to fresh-water biology and integrates the related ecological principles. Throughout the book each topic is related to the major types of natural waters. The chapter covering dissolved gases, for example, presents a general discussion of the subject followed by descriptions of gases in lakes, streams and estuaries. The author also discusses such recent advances in the field as the use of radioactive tracers, new concepts and techniques in productivity measurement and aeration concepts in stream dynamics.

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Part II. Taxonomy, Evolution and Revision of American Genera and Species. 611 pp., 83 figs. 1954–56.	$15.00

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BULLETIN
OF THE
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Vol. LVII OCTOBER, 1962 No. 4

OBSERVATIONS, INCLUDING NEW PREY RECORDS, OF SOME NEARCTIC POMPILIDAE (HYMENOPTERA)

By Frank E. Kurczewski[1]

During the summer of 1961, I collected 20 pompilid females with their prey spiders. Ten of these collections made at Presque Isle State Park, Pennsylvania, were of females of *Episyron quinquenotatus quinquenotatus* (Say) and their prey but will not be reported at this time. The other records, which include new prey species, behavorial notes on pompilids such as *Priocnemis minorata* Banks which are difficult to observe, and a 1959 record for *Anoplius (Arachnophroctonus) marginalis* (Banks) which was purposely omitted in an earlier paper (1961b), are presented below.

The prey spiders of this study and those of two previous notes (1961a, 1961b), with one exception, have been incorporated into the Cornell University insect collection under Cornell U. Lot 943, Sublot numbers P1-P39. As my two previous publications did not list specimen numbers and as these will serve as permanent records for other workers in this field, the numbers given to the specimens of the above mentioned studies are listed here. In the first paper (1961a), prey was recorded for only one species of pompilid, *Priocnemis cornica* (Say). Henceforth, these records will pertain to numbers P1 and P2. Prey spiders of the second study (1961b), with the exception of *Lycosa avida* Walckenaer (P15) which has been deposited in the Museum of Comparative Zoology, Harvard College, will be found under Sublot numbers P4-P9, P11-P12, P14, P16-P17, and P19. Prey spiders of the present study can be located by referring to the number which follows their specific determination in parenthesis.

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[1] Department of Entomology, Cornell University, Ithaca, New York.

I am deeply indebted to Dr. Willis J. Gertsch, American Museum of Natural History, for making the determinations of nearly all spider prey, and to Dr. B. J. Kaston, Central Connecticut State College, for his determination of *Arctosa littoralis* Hentz (P3), prey of *Anoplius marginalis*. I am also grateful to Dr. William T. Keeton, Cornell University, for critically reading the manuscript.

SUBFAMILY PEPSINAE

Priocnemis (Priocnemissus) minorata Banks. (Inlet Valley, Ithaca, New York, 11 May 1961, 1130 hours). In an open woodland area between two large streams, a large female *P. minorata,* 13.5 mm. long, was observed transporting its prey spider, grasping it by the bases of the hind coxae, and proceeding slowly backwards with it over dried leaf litter. During transport, the spider's body was held perpendicular to that of the wasp. After dragging its prey backwards for 14 centimeters, the wasp placed it dorsum up on a large leaf and, leaving it in that position, disappeared beneath this same leaf. After waiting 15 minutes, I placed the spider, a 12.5 mm. long adult female *Trochosa pratensis* Emerton (P20), in alcohol and removed all of the leaf litter from the immediate area. Shortly thereafter, the wasp appeared head first in the entrance of its burrow which was surrounded by a small mound of moist, dark earth mixed with small bits of leaves. After capturing the wasp, I excavated its nest. The burrow was seven millimeters in diameter. It entered the earth at an angle of approximately 40° with the horizontal, and then went nearly straight down to a depth of seven centimeters where it ended blindly. Many large roots were encountered and I had to sever several of them in order to trace the burrow. The soil in which the burrow had been dug was very moist, contained much black humus, and became increasingly sandy below a depth of five centimeters. It seems apparent that the wasp was still in the process of digging its nest when I captured it.

At this same locality on May 14, 1961 (1200 hours), I encountered another *P. minorata* female transporting its prey over a path which contained many dried leaves. Although only 12 mm. long, this female proceeded backwards at a much more rapid rate than had the first female. Its spider, a 12.5 mm. long adult female *Trochosa pratensis* Emerton (P21) was grasped in the same manner, and, as before, was placed dorsum up on a large leaf under which the wasp disappeared. I first collected the spider and later the wasp when, after 25 minutes, it came out of its entrance and began searching for its prey.

This burrow also contained the characteristic small mound of dark, moist earth around the entrance; the tunnel, which was 6.5 mm. wide, contained two slight curves and then went straight down to a depth of 18 centimeters where it ended blindly. As before, the burrow had been dug in moist, dark soil containing much humus with scattered veins of sand. In making this excavation, I had to remove several, large, round stones as well as having to sever many large roots.

Priocnemis (Priocnemis) cornica (Say). (Presque Isle State Park, Pennsylvania, 28 July 1961, 1200–1530 hours). A small female of this species, 6 mm. long, was observed throughout the afternoon of the above date hunting small lycosids in a sandy inland blow-out area. The wasp hunted mostly on foot and when not in direct contact with a spider held its wings over the dorsum of the abdomen flicking them upwards at intervals. As soon as a spider provided a stimulus, the wasp raised its wings to a nearly vertical position flicking them incessantly and either pursued the spider forward on the ground, its wings held in this position but flicking rapidly, or took flight and tried to pounce upon the spider's back. On four occasions the spiders being pursued either rapidly outran this female wasp or hid beneath pieces of decayed wood and flat stones.

Finally, after chasing a juvenile *Arctosa littoralis* Hentz (P27), 3.5 mm. long, six centimeters over the sand surface, the wasp pounced upon the dorsum of the spider and while clinging to it, bent its abdomen under and upwards placing its sting into the venter of the spider's cephalothorax. Within a few seconds the spider's legs collapsed and the wasp dismounted and cleaned its antennae with its fore legs. I then collected both spider and wasp.

(Groton, New York, 31 Aug. 1961, 1600 hours.) A female of this same, small, black species, 6 mm. in length, was observed dragging its prey spider, an immature *Pardosa sp.* probably *milvina* Hentz (P37), 5.5 mm. long, backwards up a steep slope which formed one side of a sand pit. The prey was grasped in the wasp's mandibles by a hind leg.

(Groton, New York, 4 Sept. 1961, 1530 hours). Another female *P. cornica,* 6.5 mm. long, was noted transporting a female *Pardosa moesta* Banks (P38), 5.5 mm. long, in the above manner. After dragging its prey backwards for nearly 30 centimeters, this wasp laid it dorsum up three centimeters from the entrance of an active *Sphex ichneumoneus ichneumoneus* (Linnaeus) nest, and walked forward into the open burrow. After remaining within for about 20 seconds, the female appeared head forward at the entrance, came out of the burrow onto the gravel which surrounded the *Sphex* entrance, and walked rapidly forward to its prey. After tapping the distal segments of its antennae over its prey, the wasp grasped the spider by a hind leg and began dragging it backwards towards the open nest of *Sphex*. I then collected the wasp and its prey before they reached the nest entrance. Rau and Rau (1918) and Evans (1953) have noted *P. cornica* nesting in pre-existing holes.

SUBFAMILY POMPILINAE

Episyron biguttatus biguttatus (Fabricius). (Groton, New York, 5 Sept. 1961, 1630 hours). A female of this species, 11 mm. long, was noted dragging a huge, adult female *Araneus diadematus* Clerck (P39), 13 mm. long, backwards up a vertical *Solidago* stem. The wasp grasped its prey in its mandibles by a hind leg. After pulling it up the stem to a height of nine centimeters, the wasp placed the spider dorsum up in the axil of a leaf, flew about one meter to a hard-packed sand bank near the edge of a field, and began digging its nest. In digging, the fore legs were used rapidly and simultaneously; these threw the loosened sand backwards beneath the body in a continual stream. The wasp, at intervals, stopped digging and backed out into the entrance to clear away the accumulating sand, again using the fore legs for this. After digging to a depth of only two centimeters, the *Episyron* backed out from this excavation, moved three centimeters to the right of this hole, and began another. After she had repeatedly begun a number of new excavations, the wasp was collected.

Anoplius (Arachnophroctonus) marginalis (Banks). (Presque Isle State Park, Pennsylvania, 28 June 1959, 1400 hours). While walking over an area of extensive sand dunes along the shore of Lake Erie, I observed a large, female *A. marginalis,* 12.5 mm. long, in the process of stinging a 14 mm. long male of *Arctosa littoralis* Hentz in the penultimate instar (P3), this occurring on the sand surface. The wasp clung dorsum up to the spider which was also dorsum up; its abdomen, especially the apical half, was bent under and hooked upwards, the sting apparently having entered the ventral cephalothorax of the host. After having stung its prey three or four times the wasp climbed off onto the sand surface and cleaned its antennae with its fore legs. The spider, having collapsed so that its venter was resting on its legs which were folded and bent underneath, did not move. I collected both specimens at this time. According to Evans and Yoshimoto (1962), *Anoplius marginalis* preys mostly upon large lycosids of the genera *Lycosa* and *Geolycosa;* this species has never been observed using spiders of the genus *Arctosa* as provender.

Anoplius (Arachnophroctonus) semirufus (Cresson). (Mill Creek, Erie, Pennsylvania, 26 July 1961, 1500 hours). In an abandoned gravel pit, a female *A. semirufus,* 7 mm. long, was observed carrying its prey, a female *Pardosa milvina* Hentz (P26), 5 mm. long, backwards up a steep slope. While walking backwards, the wasp held its prey in its mandibles by one of the hind coxae; the body of the spider was held nearly perpendicular to that of the wasp. At intervals, during transport, the wasp stopped, laid down its prey on the gravelly slope, and moved up the slope where it walked in erratic circles, topping the distal segments of its antennae against the ground, as though searching for a familiar landmark.

Anoplius (Pompilinus) marginatus (Say). (Groton, New York, 31 Aug. 1961, 1700 hours). A female of this very common pompilid, 9.5 mm. long, was noted dragging an immature *Xysticus sp.* (P36), 6.5 mm. long, rapidly backwards through dense grass at the edge of a gravelly path. The wasp grasped its prey in its mandibles by a hind leg and followed a circuitous route. In fear of losing the wasp and its spider in the dense vegetation, I captured both.

Anoplius (Anoplius) ithaca (Banks). (Presque Isle State Park, Pennsylvania, 30 July 1961, 1500 hours). A female of *A. ithaca,* 8 mm. long, was observed in an area of flat rocks along Lake Erie dragging its prey spider, an immature *Pardosa sp.* probably *milvina* Hentz (P29), 5.5 mm. long, backwards over a flat stone on the beach. The wasp grasped its prey in its mandibles by a hind leg.

(Wintergreen Gorge, Four Mile Creek, Erie, Pennsylvania, 19 Aug. 1961, 1400 hours). This small, all black pompilid which, according to Evans (1948), can be found along most rocky streambeds, was extremely numerous at this locality. A number of females was noted walking rapidly forward with outstretched antennae, the distal segments tapping the flat rocks which embraced the sides of the stream. One of these females, 9 mm. long, was observed flying rapidly just behind and above a small lycosid spider which dodged the pursuing wasp and ran under a large, flat rock. The wasp landed near the rock, tapping the distal segments of its antennae incessantly. Seemingly guided by olfactory stimuli, the wasp followed a very random course which eventually led it beneath the rock under which the spider had run. About 40 seconds later, the wasp emerged from under the rock dragging backwards an immature *Pardosa sp.* (P35), only 4.5 mm. long; the wasp held the spider in its mandibles by one of the hind coxae.

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Abyssal Crustacea, by J. L. Barnard, R. J. Menzies, and M. C. Băcescu. Columbia Univ. Press, New York. 1962. The foreword recounts the history of the *Vema* and summarizes her voyages of research, traveling the major passages of the world. The first chapter, "South Atlantic Abyssal Amphipods," by J. L. Barnard, presents the discovery of 38 new species and 9 genera and records 14 other species. The habits of the amphipods, whether benthic, demersal, or pelagic, were determined by a careful study of morphology and food habits. In the second chapter, "The Isopods of the Abyssal Depths in the Atlantic Ocean," Dr. Menzies characterizes 107 new species, 9 new genera and each of the 63 previously known abyssal Atlantic species. The third and final chapter, written by M. C. Băcescu of the Musée d'Histoire Naturelle, Bucharest, is entitled "Contribution à la Connaissance du Genre *Makrokylindrus* Stebbing (Crustacea, Cumacea)." This describes 6 new species and offers the first key to the 25 species assigned to this genus. (Price $10.00).

THE ULTRASTRUCTURE OF THE METASTERNAL GLANDS OF ANTS

By G. S. Tulloch, J. E. Shapiro and B. Hershenov[1]

The metasternal glands which are peculiar to the ants are paired epidermal structures located in the metathorax. They communicate with the environment through openings situated near the pleural-sternal margins. Within a species and among closely related species the glands of the males and the castes of the female are remarkably similar. Among the more diverse groups of ants variations both in shape and size are quite evident; yet in all forms a constant basic pattern is recognizable. This may be described in simple terms as a cluster of unicellular epithelial glands, each of which tapers distally and connects with the apical portion of a common cuticular sac by means of a minute canal or canaliculus. Although some study has been given to the structure of these glands, nothing is known concerning the chemical composition of the secretion, its function or how it is expelled from the cells of origin. One suggestion regarding function is that these glands synthesize a pheromone which enables an ant to recognize members of its own colony. Another is that these glands are involved in the production and distribution of a substance responsible for a trail odor.

Earlier studies employing light optics (Tulloch, 1936) reported on the structure of the metasternal glands of *Myrmica rubra*. In this paper, electron micrographic methods have been used to supplement light and phase contrast observations in determining the fine structure of these glands and especially of the canaliculi in another species of ant.

Materials and Methods

Specimens of *Myrmecia nigrocincta* were collected near Brisbane, Australia, and maintained in temporary colonies at the University of Queensland. Glands were dissected out of the thorax within one minute after decapitation and fixed in veronal-buffered osmium tetroxide following the method of Palade (1952). The glands were stored in 70% alcohol for air mail shipment to Brooklyn College where they were embedded in methacrylate (n-butyl 3 parts, methyl 1 part). Sections were prepared using diamond knives and a Porter-Blum ultramicrotome. Specimens

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[1] Biology Research Laboratory, Brooklyn College, Brooklyn 10, New York.

were stained with uranyl acetate and examined in an RCA EMU-2B electron miscoscope. Micrographs were taken at initial magnifications ranging from 2,000 to 9,500 and then enlarged photographically to the desired size. The magnification of the settings of the microscope was determined by calibration using a diffraction grating ruled at 28,800 lines to the inch.

Results—Light Optics

Some appreciation of the overall nature of the metasternal gland of *Myrmecia nigrocincta* may be gained by an examination of the schematic diagram (Fig. 1). It is made up of two main portions, a basal reservoir-like region identified as the accessory organ (A) and a secretory area (B) made up of large gland cells and their associated canaliculi. The epidermal layer is not included in this diagram nor is the sheet of delicate supporting tissue which envelops the secretory area and extends as a suspensory ligament to the roof of the propodeum. Further support to the secretory area is provided by the huge muscle masses present in the posterior region of the thorax.

Accessory organ (Fig. 1, A). This portion of the gland is a cuticular structure which is continuous with and similar in color and texture to the exoskeleton. From its external elliptical opening (C) near the pleural-sternal margin it extends forward and upward and parallels the suture between the meso- and metapleuron. At its blind end this organ converges toward the midline of the body. Its overall length is 660 microns.

The accessory organ has a lower smooth-walled portion which resembles a segment of large bowel and an upper rough-walled section ending in a blind pouch. The differences in wall texture are best discernible by observation with phase contrast (Fig. 2). For convenience the two portions of the accessory organ are referred to as the receptacle (A2) and the secretory recess (A1) respectively.

The receptacle communicates with the outside by an elliptical opening which is 25 × 40 microns. At the level of the external opening, the receptacular diameter is 270 microns while at the region adjoining the secretory recess, 400 microns forward and upward, it is reduced to a diameter of 130 microns. On the lateral face of the internal surface of the receptacle there is a single row of hairs (Fig. 1, D) whose free ends terminate at a common point at the center of the external opening. Their arrangement suggests some directive role in the transport of droplets from the secretory recess to the outside.

The secretory recess (Figs. 1 & 2, A1) is a bluntly rounded sac which varies in diameter from 130 microns next to the receptacle to 160 microns at its midpoint; the overall length is 260 microns. The roughness of its wall, noted earlier, is due to rugae (R) and sieve plates (G). The rugae are confined to the inner surface of the wall and they appear to spiral downward from the apex of the recess to the receptacle. The sieve plates are thickened cuticular areas which receive the canaliculi. They are quite smooth

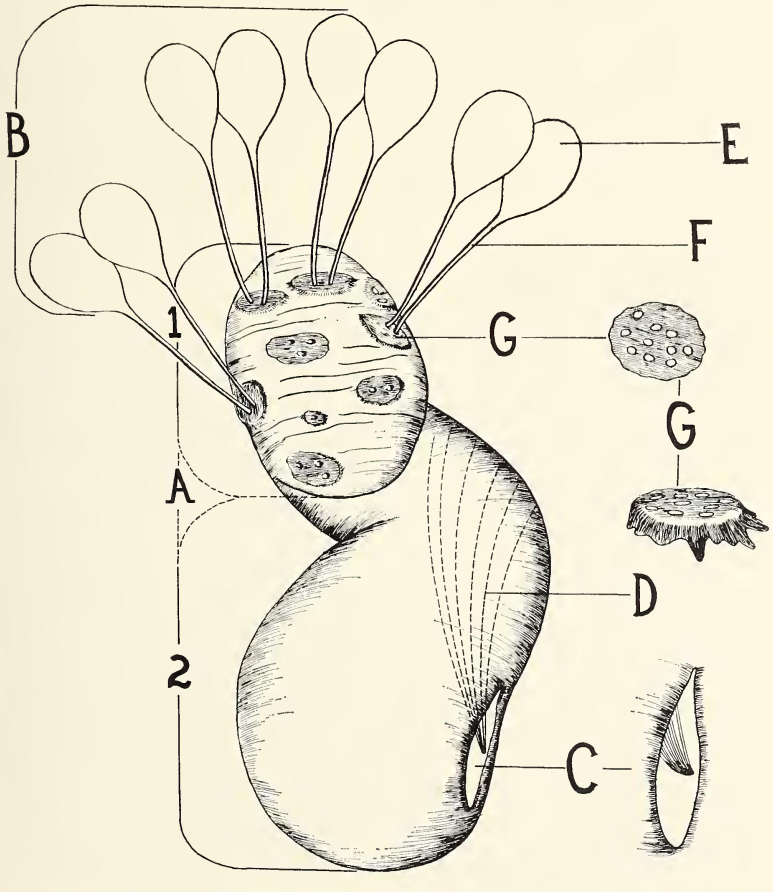
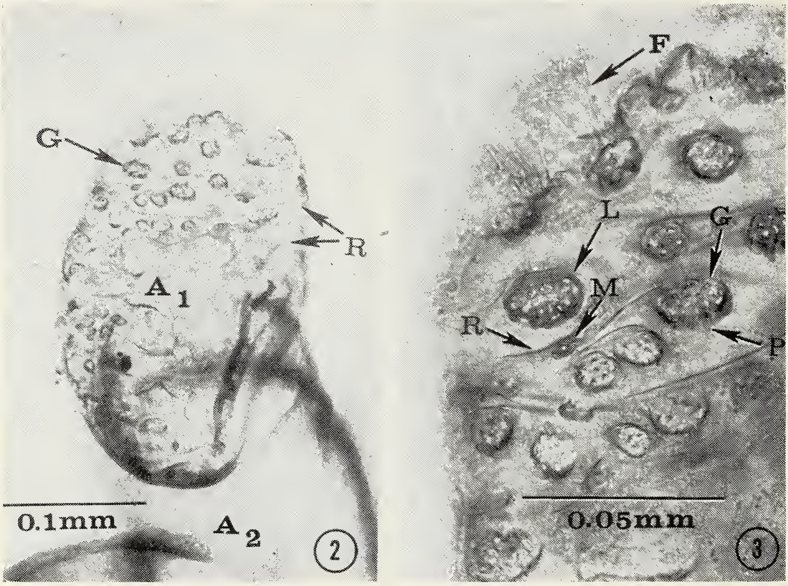


Fig. 1, Reconstruction of a metasternal gland of *Myrmecia nigrocincta*. A, accessory organ; A1, secretory recess; A2, receptacle; B, secretory area; C, opening of gland; D, hairs; E, body of unicellular gland; F, gland neck (canaliculus); G, sieve plate.

on the outer surface but very irregular on the inner surface due to many projections of unequal lengths (Fig. 3, P). The sieve plates vary greatly in size and in the number of canaliculi they accommodate. Some receive only a single canaliculus and are not more than 5 microns in diameter (Fig. 3, M) while others may be 20 microns in diameter (Fig. 3, L) and may provide drainage for as many as 13 canaliculi.

Secretory Area (Fig. 1, B). In *M. nigrocincta* this area is composed of about 700 unicellular glands which form a cap over the upper portion of the accessory organ. Each gland cell is made up of a body portion (E) which is about 25 microns wide and 40 microns long. From the inner end of the long axis a narrow canaliculus (F) of a uniform diameter of less than 1 micron and varying in length from 50–125 microns connects the glandular portion to pores of the sieve plates. In sectioned cells it was seen that the nuclei usually are eccentric and the canaliculus of its cell retains its external structural integrity intracellularly for a short distance. It is not possible from light optical studies to distinguish any detail in the canaliculus itself or to



Figs. 2 & 3, Phase contrast micrographs of portions of the accessory organ. Captions A–G as in Figure 1. L, sieve plate with many openings; M, with a single opening; P, cuticular projection; R, rugae.

determine how it joins with the secretory recess of the unicellular gland.

RESULTS—ELECTRON OPTICS

Orientation. The observations reported here are restricted to those which permit a new interpretation of structure over that provided by light and phase contrast studies. Emphasis will be placed on the canaliculus particularly at its connection with the accessory organ and its course to and within the unicellular gland and will include, as well, any cytoplasmic bodies which appear to be associated with it. From the first sections observed in the electron microscope it was apparent that a new explanation of canalicular structure was necessary not only for these glands but probably for other similar organs of ants such as the mandibular and gastric glands (Whelden, 1960). It also was recognized that the findings from the canaliculus of the metasternal glands might be applicable to similar glands found throughout the insects.

In order that terms may be defined more precisely and the structure more easily visualized, several simple diagrams (Fig. 4, a–f) have been provided for examination prior to a study of the electron micrographs. Presumably the glands originate from undifferentiated epidermal cells (a-1) which lie beneath the cuticle (a-2). A single cell enlarges and invaginates (b) resulting in a precursor gland cell containing a blind tube (c). The cell membrane, as well as the tube, maintain continuity with the tissue of origin in the body wall. The neck-like portion of the cell elongates (d) and the blind tube within assumes a tortuous course and coils around the nucleus (e). As the tube penetrates deeper into the cell its blind portion becomes modified as a fringed structure and can be considered an arborescent absorbing entity (f).

With light microscopy the canaliculus was considered to be divided into two portions: (1) an intracellular region which extended for a short distance within the body of the gland cell and (2) an intercellular section which somehow fused with the intracellular portion and the cell membrane to form a slender connection between the body of the cell and the accessory organ. As indicated in the diagrams and as will be seen in the electron micrographs later, the canaliculus is a far more complex structure than originally supposed. It is intracellular in its entirety and takes the form of a minute canal which extends from the accessory organ into the lower portion of the cell body at which point it expands to form an absorbing unit. It is proposed that the term canaliculus be defined as the entire blind intracellular organelle which is continuous with the cuticule. The term gland neck is proposed for that segment of the cell which extends from the cell body to the sieve plate and includes the entire complex of central canaliculus, cortical cytoplasm and the limiting cell membrane. This use of the term gland neck (Fig. 4, e–n) serves to emphasize the continuity of the gland cell with the epidermis from which presumably it is derived.

Accessory organ. The wall of this organ is made up of a layer of epidermal cells and cuticle. It is penetrated by canaliculi via sieve plates randomly disposed over the secretory recess. A

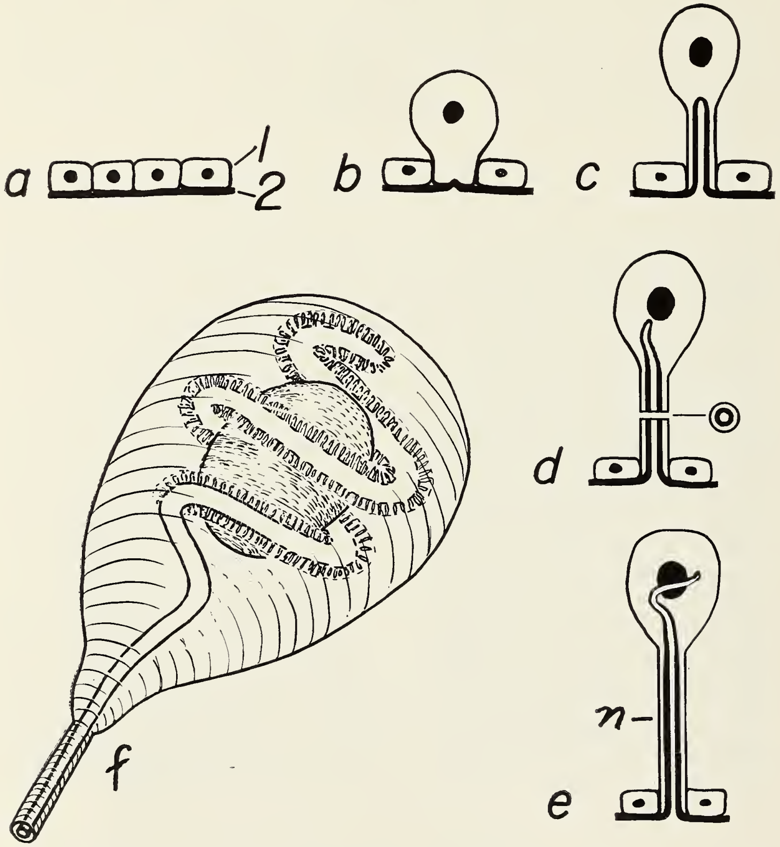


Fig. 4, Sketches to illustrate possible development of a unicellular gland. 1, epidermis; 2, cuticle; n, gland neck.

section taken through a sieve plate parallel to the outer face (Fig. 5) shows the perforations; the swirls in the foundation cuticle very likely follow the course of the rugae noted with phase contrast. The character of the wall at the epidermal level just off the surface of a sieve plate (Fig. 6) demonstrates the presence of one canaliculus per cell.

Secretory area. The necks of the glands vary in length and in angle of departure from the accessory organ. They may be cut transversely (Fig. 8) in some sections and longitudinally in others (Fig. 7). In either aspect the structure suggested earlier of a central canaliculus, a cortical cytoplasm and a delimiting cell membrane is apparent. The canaliculus occupies the major portion of the gland neck and this is particularly conspicuous in a longitudinal section (Fig. 7). The spatial dominance of this organelle in the gland neck accounts for the misconception of light microscopists that the canaliculus was an independent connection between the cells and the accessory organ.

In order to show the interrelations of the various organelles which are to be described in detail later, a low power micrograph of a substantial portion of the body of a cell has been included (Fig. 8) for orientative purposes. This is a section through the lower portion of a cell and is about mid-way between a transverse and a longitudinal cut. It shows four sections of a single canaliculus, the one at five o'clock is at a point where the gland neck merges with the body of the cell while the others, which are structurally more elaborate, are at higher levels in the cell. The dark staining bodies, mitochondria, and the secretion droplets and granules which occur in proximity to the canaliculus will be described later.

In the gland neck and in the lower part of the cell body the cuticle of the canaliculus has two layers, an inner epicuticle, surrounding the lumen, and an outer endocuticle (Fig. 6). The epicuticle has a greater electron density than the endocuticle and is about one tenth as thick. Of interest but not further considered here is the presence of three sublayers in the epicuticle (Fig. 9, insert).

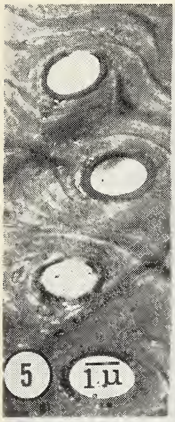
From its entrance into the body of the cell until its termination as a blind absorbing entity, the canaliculus undergoes a spectacular metamorphosis. The first indications of change are an increase in the thickness of the endocuticle and the presence of an ensheathing reticulated zone giving to the organelle a three-layered (Fig. 9) rather than a two-layered appearance noted above. It is not possible to determine directly whether the new layer arises from the cytoplasm or the cuticle. There is, however, a suggestion of cuticular origin since it along with the two inner layers survives cytologic disintegration longer than other cytoplasmic organelles. Regardless of its origin, all further modifications of the canaliculus are referable to the three layers of this anlage, i.e., (1) inner epicuticle, (2) middle endocuticle and (3) outer reticulated layer.

All three layers extend to the blind end of the canaliculus. The inner one is the only one to retain its basic architecture throughout but its continuity is progressively interrupted and it finally exists as isolated patches of cuticular material (Figs. 10–12). The middle layer becomes diffuse and granular and enlarges in dimension. The outer reticulate layer expands radially and extends as a large halo made up of a system of anastomosing intracellular cords (Figs. 10 & 11). These appear to be more distinct as well as more widely separated in the region of the blind end (Fig. 12). Their internal structure can be observed in the transverse sections (Fig. 11, cx).

There is no sharp demarcation between the outer layer of the canaliculus and the cytoplasm but rather a continuity of cell substance into the cords. Large numbers of mitochondria are concentrated around the organelle (Figs. 10 & 11) and near the blind end their arrangement is almost that of an interrupted casing (Fig. 12). Heavy deposits of secretion droplets and granules also are present in the areas adjoining the canalicular

EXPLANATION OF PLATE

Electron micrographs of sections of the metasternal glands. Fig. 5, frontal section of a sieve plate; Fig. 6, frontal section through epidermis just above a sieve plate; Fig. 7, gland necks; Fig. 8, oblique section through body of cell and gland necks (n). Four sections of a single canaliculus (F) are indicated; Fig. 9, Detail of a canaliculus with three layers, 1, 2, 3. Insert shows canaliculus in two layered condition—note the sublayers of the epicuticle; Fig. 10, Cross section of canaliculus at deeper level—note the three layers; Fig. 11, Longitudinal section of canaliculus (F). Note the interrupted epicuticle (1), the mitochondria (m), secretion droplets (sd) and intracellular cords in cross (cx) and longitudinal (cl) section; Fig. 12, Canaliculus near its termination in body of cell. Note arrangement of mitochondria (m) and remnant (1) of epicuticle.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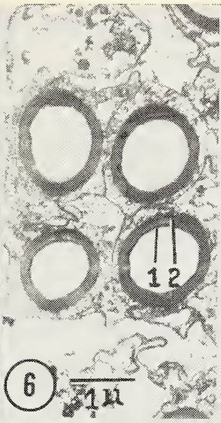
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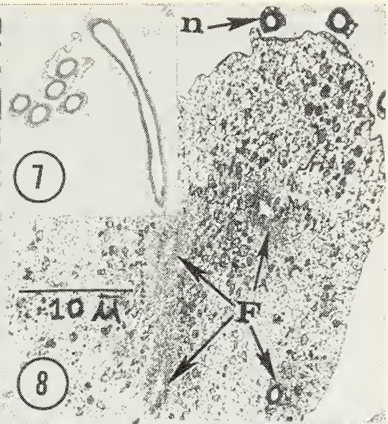
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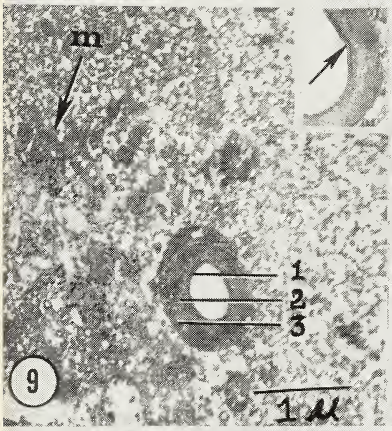
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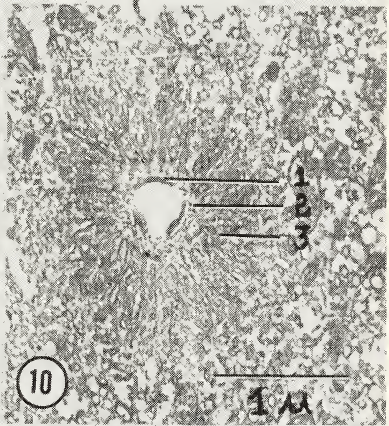
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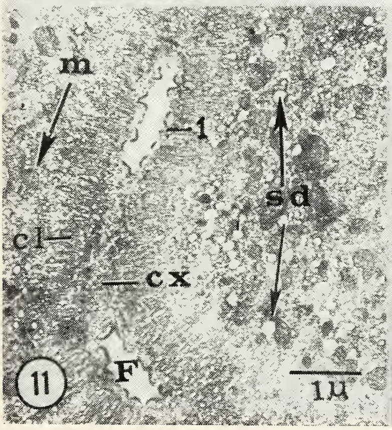
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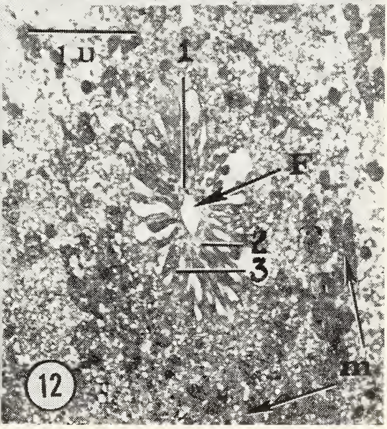
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sections (Figs. 10–12) and have been observed in the lumen of the canal as well.

DISCUSSION

Except for the division of the accessory organ into two regions and the "patchy" manner in which the gland necks of the secretory cells engage the accessory organ, the extra-cellular features Within the cell, however, there is less agreement and the electron of the gland reported here are similar to those of *Myrmica rubra.* micrographic observations allow a more accurate and modern interpretation of the cytologic structure. Golgi bodies were not observed in the present study and the objects so identified in the earlier light optical work now are thought to have been the precipitation of silver around aggregates of secretion droplets. The apparent absence of mitochondria in *M. rubra* and their abundant presence in *M. nigrocincta* merely points up the limitations of light microscopy and further emphasizes the desirability of electronmicrographic studies on this and related glands as advocated by Roth and Eisner (1962).

With light microscopy it was assumed that the canaliculus was inter- as well as intracellular and that within the cell it ended as an open conduit. Electron microscopy reveals that the canaliculus is an intracellular organelle which is structurally well-adapted for the collection and transport of secretion products. The architectural adaptation at any point along its course is consistent with the major activity of the canaliculus at that level. Deep within the gland cell where the main function would appear to be collecting secretion, it has a diffuse arborescent periphery, a granular middle layer and an interrupted inner layer permitting flow into the lumen. At the emerging level near the gland neck the canaliculus appears as a discrete tube with an intact epicuticle, an organization correlative with transport as well as for the prevention of seepage of secretion products out of the canal.

In addition to the new features of the canaliculus, the electron optical studies have established the existence of another class of organelles, the mitochondria. They are of small size and not unlike those which have been described from other insects. Of considerable interest is the distribution of these mitochondria which are found in heavy concentrations along with numerous secretion droplets around the canaliculus. The conducting portion, the lumen, of a canaliculus is about one micron in diameter, a tube so small that even water would not be subject to gravitational movement. Under these circumstances, i.e., proximity and abundance of the mitochondria to the extremely low-calibered canaliculus, it would appear that active transport rather than passive permeability is the mechanism responsible for the discharge of secretory products not only into but along the canaliculus to the secretory recess of the accessory organ. Moreover, it is possible that the mitochondria may themselves be involved in the synthesis of secretion droplets. Such a role was suggested by Mercer and Brunet (1959) for the mitochondria in the cells of the collaterial gland of the cockroach.

Once within the accessory organ the secretory products are in a relatively inflexible cuticular sac which has a row of hairs pointing toward a fixed opening to the lateral environment. The movement of the products both as liquids and vapors is probably by gravitation, and is possibly hastened somewhat by a bellows effect created by continguous leg muscles. It is difficult to ascribe any function to a substance deposited on either side of an ant's trail although it may represent the first use of a self-generating homing beam.

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PUBLICATIONS RECEIVED

The Anobiidae of Ohio (Coleoptera), by R. E. White. Ohio State Univ. Press, Columbus, 58 pp., 28 figs. 1962. This paper is a survey of the species of Anobiidae which are known to occur in Ohio or which are likely to be found in the state. Complete keys to species have been included. Short descriptions of each species are given including only the more important characters. Larval food habits are included where this information is available. (Price $1.00)

THE BIOLOGY OF *DAHLBOMINUS FUSCIPENNIS* (ZETT.) (HYMENOPTERA), AN INTRODUCED PARASITE OF PINE SAWFLY PREPUPAE

By Marvin L. Bobb[1]

A serious outbreak of the Virginia pine sawfly, *Neodiprion pratti pratti* (Dyar), began in Virginia in 1957 when three small areas less than an acre each in size were defoliated in Louisa, Cumberland and Mecklenburg counties (Morris[2]). Heavy defoliation occurred over a wider area the following year, and in 1959 more than two million acres of pine forest, comprising all or parts of approximately forty counties, had some degree of defoliation. During 1960, defoliation was present over most of the eastern counties, with the areas of heaviest infestation shifting toward the north and east. The pattern appears to be two consecutive years of heavy defoliation followed by a striking decline in the sawfly population the third year.

The Virginia Division of Forestry obtained a culture of the introduced chalcid parasite, *Dahlbominus fuscipennis* (Zett.), from New Jersey in 1959 and began to rear and liberate the parasite in infested pine stands. This species is widely distributed throughout Europe as a parasite of several species of pine sawflies. In 1934 large numbers of individuals were imported from Hungary to Canada (Morris and Cameron, 1935). Since 1940, attempts to establish the parasite in the United States have been made in Alabama, Tennessee, Michigan (Benjamin, 1955) and New Jersey. A small number of Virginia pine sawfly cocoons were found parasitized by *Dahlbominus fuscipennis* in Fluvanna and Cumberland Counties, Virginia, previous to any liberations in the state.

The study of the biology of *Dahlbominus fuscipennis* (Zett.) is the first of a series to be published by the author on studies begun in 1959 on the parasites of the Virginia pine sawfly.

METHODS

Pairs of *Dahlbominus* individuals were confined in shell vials with pine sawfly cocoons and kept under observation until the female had completed egg deposition. Each cocoon was then cut open and the sawfly prepupa and *Dahlbominus* eggs removed.

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[1] Entomologist, Virginia Agricultural Experiment Station, Piedmont Fruit Research Laboratory, Charlottesville.

[2] C. L. Morris, Virginia Division of Forestry. Correspondence.

These were transferred to a number 5 gelatin capsule, and the capsule placed in a wooden rack in a constant temperature and humidity cabinet. Each cabinet contained a thermometer and a SERDEX hygrometer which could be observed through a glass door. An electric fan constantly circulated the air within the cabinet. The temperature was thermostatically controlled and a saturated solution of sodium acetate was used to control the relative humidity. This chemical kept the relative humidity between 73 and 77 percent, depending upon the temperature.

Several thousand individuals were reared at six different constant temperatures, ranging from 60° F. to 85° F. Observations were made at frequent intervals during each day to ascertain egg hatching, larval molts, pupation and adult emergence. Measurements were made on the width of the head capsule, and the width and length of the larva, at frequent intervals; often 5 to 8 times between molts. All measurements were made with the aid of a micrometer disc in the eyepiece of a binocular microscope at a magnification of from 60 to 80 times. Many of the measurements were checked by personnel from the Virginia Division of Forestry. The use of gelatin capsules proved excellent for studies on the biology, since the individual parasites could be clearly observed and measurements made at all times without any apparent distortion.

Life History

Adult females of *Dahlbominus fuscipennis* deposited their eggs within the cocoons of sawfly prepupae, and the parasite larvae fed upon and destroyed the host. From 6 to 7 generations of the parasite occurred during the summer of 1961 under outdoor conditions in southeastern Virginia. The parasites overwintered as partially developed pupae within the host cocoon. Pupae removed from hibernation between December and February required 3.5 days to complete their development and to emerge as adults at 75° F. Under natural field conditions, the adult parasites began to emerge in early April at the time sawfly eggs were just beginning to hatch.

Descriptions of the stages and life history data are presented below. The total life cycle from egg to adult varied from 15.5 days at 85° F. to 39 days at 60° F. (Table 1). A temperature of 60° F. was near the minimum at which development would proceed.

The Egg.—When first oviposited the egg was pearly-white in color, oval but slightly curved longitudinally, and slightly larger at the anterior end. As the embryo developed, each end of the egg became clear and transparent. The egg measured from 0.34 mm. to 0.36 mm. in major axis and from 0.11 mm. to 0.12 mm. in minor axis at the cephalic end. They adhere to each other and to the sawfly prepupa.

The Larva.—There were five larval instars. A considerable variation occurred within each instar in the size of the larvae, depending upon the amount of available food. However, all measurements given below are for individuals which had an abundance of food during larval growth, and size variations due to starvation were minimized.

The head capsule width of those larvae destined to become males was slightly narrower than those destined to become females. Thus, the smaller head capsule width given for each instar was almost always that of the male, whereas the larger width was that of the female. It was possible to sex the majority of the first and second instar larvae by this difference in head capsule width. This was also true of later instars when sufficient food was available for normal growth, but due to starvation, diminutive forms occurred from the third through fifth instars under crowded conditions. The parasite larvae fed externally on the sawfly prepupa within the host cocoon. The duration of larval development varied from 6 days at 85° F. to 16.5 days at 60° F.

First Instar: When the embryo was fully developed, the larva split the larger end of the chorion and gradually wiggled out. The primary larva had a very large head, and thirteen body segments which tapered posteriorly. The body was transparent when first hatched and the opaque-white internal organs were visible, but after feeding for several hours the integument became a uniform white color. The length of the larvae varied from 0.35 mm. just after hatching to 0.42 mm. before the molt, and the head capsule width varied from 0.070 mm. to 0.098 mm.

Second Instar: These larvae resembled those of the first stage except in size. The length of the larvae before the molt averaged 0.58 mm., and the head capsule width varied from 0.112 to 0.128 mm.

Third Instar: A pair of tubercles, one on each side of the vertex, became prominent after molting to the third instar. The larvae grew rapidly with constant feeding and became dirty-white in color due to the body contents. By the end of the third stadium individuals averaged 0.98 mm. in length, and the head capsule width varied from 0.140 mm. to 0.168 mm.

Fourth Instar: The parasite larvae were gray in color due to the accumulation of food and waste materials within the body. The larvae had a much smaller head in relation to the body and it was partially embedded in the body segments. The body was widest near the middle. Mature fourth-instar larvae averaged 1.40 mm.

in length, and the head capsule width varied from 0.196 mm. to 0.224 mm.

Fifth Instar: The larvae fed only intermittently during this stage, and no feeding took place during the day or two preceding the molt. The body color was grayish-black; otherwise the larvae resembled those of the fourth instar except for their larger size. The length of the individuals varied from 2.34 mm. to 3.21 mm. The width of the head capsule varied from 0.280 mm. to 0.308 mm.

The Prepupa.—Defecation took place with the change to the prepupa. When the body contents had been expelled the color of the prepupa was white. The portion posterior to the head was elongated and narrower in width than the abdominal segments.

The Pupa.—The individuals pupated within the host cocoon and did not construct a cocoon of their own. The wing pads and leg rudiments were clearly visible and held close to the body. When first formed the pupa was a uniform white color, including the eyes; but after several hours the color changed to a light brown. When about 3 days old, the eyes and ocelli began changing to a reddish color, but the color of the body remained a light brown. By the fifth day after transformation, the eyes and ocelli were very dark red and the abdominal segments were beginning to darken along the intersegmental margins. A few hours later the pupa was a uniform black color. The pupae averaged 2.42 mm. in length for the males and 2.92 mm. for the females.

The Adult.—The head, thorax and abdomen are black. The eyes are large and dark red in color. The femur of the legs is black but the remaining segments are white to light brown. The antennae are black in both sexes, with the exception of the scape, which is white in the female. The antennae are elbowed, with the segments distal to the scape claviform in the female and pectiniform in the male. The wings have a smoky tinge and have little venation. The slender ovipositor averages 0.8 mm. in length, and rests in a groove along the underside of the abdomen. It is attached under a flap near the base of the abdomen and the tip extends to the most posterior segment.

Dahlbominus adults varied greatly in size, depending upon the abundance of food during larval growth. When sufficient food was available during all larval instars, the adults averaged 2.80 mm. in length for the females and 2.29 mm. for the males. In emerging from the host cocoon, a hole averaging 0.54 mm. in diameter was chewed in the side of the cocoon near one end. The adults generally moved by short hops, but were capable of short flights.

The length of life of the adults varied from 6 to 10 days at 75° F., and averaged 8 days.

Sex Ratio: Fertilized eggs produced females greatly in excess of males. The progeny from several hundred mated females was 81.8 percent females. Unfertilized females oviposited in sawfly cocoons, and produced all male offspring.

Mating and Ovipositing: The males and females mated soon after emergence, and the females began egg-laying a short time thereafter. Each female walked slowly over the cocoons, feeling them with her antennae. After a varying period of time she selected a cocoon for egg deposition. She stood high on her legs and moved the tip of the abdomen forward until it was directly under the base of the abdomen. The abdomen then was quickly moved back to its normal horizontal position, leaving the slender ovipositor in a vertical position under the base of the abdomen.

The female spent from 10 to 15 minutes in the process of getting the ovipositor through the tough sawfly cocoon. From the tip of the ovipositor was ejected a white fluid in which the female constantly rotated the ovipositor back and forth one-half turn while drilling through the cocoon. When the ovipositor had penetrated the cocoon, the female thrust it to its full depth, frequently moving it up and down a few times. The sawfly prepupa became paralyzed during this operation. The ovipositor was then slightly withdrawn and the eggs deposited externally on the host prepupa or loose within the cocoon.

Miller (1940) indicated that the majority of the parasites oviposited but once and in one cocoon. During the course of the studies reported herein, numerous observations were made on oviposition habits. After depositing eggs for approximately 6 to 8 minutes, the female withdrew her ovipositor and rested on the cocoon for 45 to 50 minutes. She then reinserted her ovipositor in the same cocoon and deposited a second batch of eggs. This process was usually repeated a third time, and at each insertion of the ovipositor from 9 to 12 eggs were deposited in the host cocoon. Occasionally a female would oviposit a few eggs on the succeeding day. Data on the total number of eggs laid by individual females in captivity showed an average of 29.3 with a minimum of 20 and a maximum of 38. Emergence of *Dahlbominus* adults from a number of field-collected cocoons varied from 20 to 45 and averaged 32.5 per cocoon. The *Dahlbominus* population was extremely light and it was assumed that only one female oviposited in each cocoon. However, more than one adult may oviposit in an individual cocoon if given the opportunity, and as many as 121 parasite adults have been reared from a single sawfly cocoon.

Size of Adults as Affected by Food: It was observed that a wide variation existed in the size of adult females. An experiment was made to determine if this size variation was due to the amount of food available during larval growth.

Various numbers of *Dahlbominus* eggs were placed on sawfly prepupae in gelatin capsules and reared to maturity. The number of eggs used per prepupa was 1, 5, 10, 25, 50, 75 and 100. One parasite larva killed the sawfly prepupa but matured with no visible evidence of feeding on the host. Five or ten larvae devoured from one-half to three-fourths of the prepupa by maturity. The adults in these three groups were slightly larger than normal. When 25 parasite larvae fed on the host only the head and skin of the prepupa remained at the completion of feeding. The adults were normal in size, 2.29 mm. to 2.80 mm. in length. Fifty larvae devoured all of the host prepupa by the early fourth instar and the adults were slightly smaller than normal size. Seventy-five and 100 parasite larvae devoured the host by the time they were in the late third or early fourth instar. Their adults were very small, varying from 1.75 mm. to 1.90 mm. in length.

Hyperparasitism: Dahlbominus females have a strong tendency toward hyperparasitism. When given the choice of cocoons containing a sawfly prepupa and those containing *Exenterus* or *Villa* parasite larvae, the female most often selected the one with the parasite larva. Morris and Cameron (1935) stated that in Hungary 71 percent were primary and 29 percent were secondary parasites.

TABLE 1.—**Summary of life history data on *Dahlbominus fuscipennis* (Zett.) showing the number of days in each stage of development, 1960–62.**

Stage of Development	Constant Temperature (°F.)					
	60	65	70	75	80	85
Egg	3	3	2	2	2	2
First Instar	3	2	1	1	1	1
Second Instar	1.5	1	0.5	0.5	0.5	0.5
Third Instar	1.5	1	0.5	0.5	0.5	0.5
Fourth Instar	2.5	2	1	1	1	1
Fifth Instar	8	6.5	5	4	3.5	3
Prepupa	2	1.5	1	1	1	1
Pupa	17.5	10.5	8	7	7	6.5
Total	39	27.5	19	17	16.5	15.5

SUMMARY

The results of studies on the life history and habits of *Dahlbominus fuscipennis* (Zett.), an introduced parasite on pine sawfly prepupae, are presented.

The eggs were deposited within the host sawfly cocoon and hatched in from 2 to 3 days depending upon the temperature.

There were five larval instars and the duration of each stadium at a constant temperature of 75° F. was: first, 1 day; second, 0.5 day; third, 0.5 day; fourth, 1 day; and fifth, 4 days. The prepupal period lasted 1 day, and 7 days were spent in the pupal stage. The total life cycle from egg to adult varied from 15.5 days at 85° F. to 39 days at 60° F.

Dahlbominus adults varied greatly in size, depending upon the amount of food available during larval growth. The length of adult life averaged 8 days.

Fertilized females produced females greatly in excess of males, and the progeny from unmated females were all males.

The complete oviposition took many hours. The number of eggs deposited by individual females in captivity varied from 20 to 38 and averaged 29.3.

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Pacific Insects—A quarterly journal devoted to systematics and zoogeography of terrestrial arthropods of the Pacific area, including E. Asia, Australia and Antarctica. Vol. 1 (1959) of 505 pages: Vol. 2 (1960) of 461 pages: and Vol. 3 (1961) of 589 pages. Price of volumes 1–3 is $5.00 per volume. Vol. 4 (1962) to be more than 800 pages, priced at $7.00. Order from Entomology Dept., Bishop Museum, Honolulu 17, Hawaii.

STUDIES OF THE *GYPONINI* (HOMOPTERA: CICADELLIDAE): THE *GYPONA GLAUCA* (FABRICIUS) COMPLEX

By Dwight M. DeLong and Paul H. Freytag
The Ohio State University

The genus *Gypona* was erected in 1821 by Germar who designated *Cercopis glauca* Fab. (described 1803) as the type. Until the summer of 1960, some 139 years later, no one had studied the male holotype sufficiently to determine the specific genitalic characters and illustrate these. This was made possible through the kindness of Dr. S. L. Tuxen and his associates in the University Museum at Copenhagen.

Other museums were visited in order to study and illustrate the characters of related species of types of *Gyponini*. Through the kindness of Dr. W. E. China and Dr. R. J. Izzard, the Walker and Fowler types were studied in the British Museum. Dr. Eric Kjellander has kindly permitted the study of all of the Spangberg and Stal types in the Stockholm Museum and Dr. Max Beier has likewise permitted a detailed study of the Spangberg types in the Vienna Museum.

The present study and presentation is an attempt to define and illustrate all of the species found in the collections available for study both in Europe and in the United States. A portion of the Genus *Gypona* including *glauca* and its relatives are treated at this time. All of this material is from South and Central America.

Unfortunately a good series of specimens of a species of this group has seldom been collected. As a rule, a single specimen or very few specimens represent a species and these are usually confined to one sex. The specimens representing a species may be from only one locality or possibly from two widely separated countries.

The color patterns of several species are so similar, and the intensity of color varies so much within a species, that it is impossible to identify or separate them without the use of genital structures. This poses a very difficult problem because males are holotypes in some cases and females are holotypes in other species. The opposite sex is usually not represented, consequently there are no allotypes and the opposite sex of the described species cannot be accurately or logically identified from the available material. In a few cases where males and females from different localities have been placed together, it is obvious that they represent two species. No attempt has been made to guess the opposite sex of any species.

Only by intensive collecting in the future will one be able to establish the characters of both sexes of these species.

The male structures of the genital chamber offer excellent characters for the separation of the species of this group.

The posterior margin of the female seventh sternite is somewhat variable but is considered to offer diagnostic structures. Because of inability to match the two sexes, the females have been described in some cases as an aid in establishing identification for the material at hand.

Gypona decorata Fowler

Gypona decorata Fowler, 1903, p. 311.

A blunt-headed robust species with the crown thickened. Length of male 10.5 mm, female 12 mm.

Crown short, broad, scarcely produced, parallel margined, more than three times as broad as long, with anterior margin thick. Ocelli large, distant, nearer eyes than median line. Pronotum more than four times as long as crown, much broader than head, with humeral angles conspicuous.

Color: Yellowish. Pronotum with dark brown and reddish flecks; anterior half and median area marked with brown. Scutellum dark, with a pale area just before apex. Fore wings pale, with heavy brown markings in the form of spots on anterior third, with median portion and apical third producing a banded appearance. Venter pale with reddish and pink markings.

Genitalia: Female seventh sternite (Fig. 28) concavely excavated between the lateral angles and pointed projections, between which posterior margin deeply, concavely excavated for about one-third its width at middle. Male (Fig. 4a–f) with plate more than twice as long as wide, apex truncate and broader than base. Style narrowed at two-thirds its length to form an enlarged apex which is bent dorsolaterally more than one-third its length and tapered to form a long slender spine-like apex. Aedeagus elongate, with a process arising on either side just before narrowed bluntly pointed apex. In lateral view, aedeagus broad on basal half, then gradually narrowed to a slender upturned apex which bears a pair of short spine-like processes at its base; just below these, where shaft is thicker, a pair of longer processes arising and curving ventrocaudally; these processes more than half as long as aedeagus. Pygofer bearing a very short rounded process on dorsocaudal margin.

Notes: This species was described from a single male holotype labeled "Bugaba, Panama." Other specimens of this species which were examined are: A specimen in the Carnegie Museum collection labeled "Upper Rocana, N. Para, Brazil, S. M. Klages, C. M. Ac. 6175"; a male specimen in the North Carolina State College collection labeled "Guyane Francaise, Les Hattes, Bas Maroni, Coll. Le Moult," and a series of females from the same locality which are similar in size and color and apparently belong with the male; and a male specimen in the DeLong collection labeled "Bartica, Br. Guiana, March 20–30, 1901."

Gypona versuta Spangberg

Gypona versuta Spangberg, 1881, p. 27.

A pale species marked with black and related to *melanota*. Length of male 11 mm.

Crown broadly rounded, one and one-half times as wide between eyes at base as median length, with a series of reflexed arcs next to each eye, with anterior margin thin and turned up.

Color: Crown yellow, with anterior margin and spot next each eye black. Pronotum yellow, with area behind each eye, a round spot about middle on each side, and a broad band on posterior margin black. Scutellum yellow, with a pair of round black spots near middle. Fore wings pale, basal half of claval area and claval veins dark, other veins and apical portion mostly brown.

Genitalia: Male (Fig. 5a–f) with plate about twice as long as basal width, broad as base and tapered to a blunt apex Style sickle-shaped, curved dorsoventrally, constricted and narrowed at middle, slightly enlarged toward apex, then tapering to a long slender tip. Aedeagus broad at base, rapidly narrowed to shaft which is gradually narrowed to a slender bent apex; a pair of large, long, curved processes arising where tip is bent and extending to base; a pair of short, slender processes arising just dorsad of other pair. In ventral view, shaft of aedeagus appearing slender and straight with long, paired proceses beside it on each side.

Notes: The holotype male from Brazil has been studied and the genital structures are illustrated. Three other male specimens have been studied. Two of these, in the Vienna Museum collection, are labeled "Schott-Brasilien"; the other one, in the Carnegie Museum collection, is labeled "Prov. del Sara, Bolivia, 450 M., J. Steinbach, Nov. 1909, Ac. 4549." All specimens are marked with different intensities of color, but the genital structures are the same.

Gypona stylata, n. sp.

In form and general appearance resembling *glauca* but with darker color markings and distinct male genitalia. Length of male 11.5 mm.

Crown flat, wide, broadly rounded, almost twice as wide between eyes at base as median length, with anterior margin thin and foliaceous. Ocelli closer to each other than to eyes.

Color: Pale yellow, heavily marked with black. Crown almost entirely black; with a small area just before and on outer margin of each ocellus, a small area just posterior to each ocellus, and inner margin of each eye yellow. Pronotum black, with a pale curved area on each side extending from near anterior margin to posterior portion of each humeral angle. Scutellum yellow, with a large dark transverse spot on central portion. Fore wings yellowish; with dark veins, basal portion of clavus and apical cells black.

Genitalia: Male (Fig. 6a–f) with plates broadened apically and broadly rounded. Style abruptly narrowed and produced apically. Aedeagus with a pair of long apical processes which are directed basally and extending more than half way to base of aedeagus, also with a pair of short spur-like processes arising at tip of apex and directed basally. Pygofer with an apical spine.

Holotype male: Mt. Duida, Venezuela, 4 Nov. 1928, Ac. 29500, Tate No. 138. Holotype in the American Museum collection, New York.

Gypona lativitta Walker

Gypona lativitta Walker, 1858, p. 102.

A distinctly marked species with a short, broadly rounded head with a thin foliaceous anterior margin. Length of male 11.5 mm.

Crown broadly rounded, almost parallel margined, about twice as wide as median length, surface flattened or concave, with anterior margin thin and foliaceous. Ocelli closer to each other than to eyes. Pronotum more than twice as long as crown.

Color: Crown black, with four pale yellowish spots arranged transversely anterior to ocelli. Ocelli lying at caudal edge of central spots Pronotum bright yellow, with a narrow black margin on each side and a median elongate band about one-third width of pronotum which broadens gradually to form a transverse black band across posterior margin. Scutellum yellow, with a median black spot. Fore wings yellow; subhyaline; with basal half of clavus, claval veins, a median spot on costal-discal area, and apices dark brown to black.

Genitalia: Male (Fig. 7a–f) with plates elongate, more than three times as long as broad, with apex broad and almost truncate. Style broadened at one-third its length, then gradually narrowed and again enlarged at three-fourths its length where it curves outwardly forming a rather long, tapered, pointed apical portion. Aedeagus broad at base and gradually tapered to a narrow, blunt apex; apical fifth bent dorsally and bearing two pairs of short narrow processes which arise near base of apical portion. In ventral view, aedeagus elongate and almost parallel margined. Pygofer bearing a short, broad dorsocaudal spine with a serrate edge.

Notes: The holotype is a male and there is no label on the pin. Other specimens examined are: A male in the Carnegie Museum collection labeled "Mana River, Fr. Guiana, May 1917, Ac. 6068"; a male in the National Museum collection labeled "Santarem, Coll. C. F. Baker"; and a male in the Stockholm Museum collection labeled "Cayen Dupui Zet," and previously identified as *"glauca."*

Gypona obstinata, n. sp.

Resembling *glauca* in general form but with heavy black coloration. Length of male 11 mm.

Crown rather broad, more than half as long at middle as basal width between eyes, with anterior margin broadly rounded.

Color: Crown and pronotum (Fig. 3) black with yellow markings. Crown black, with an elongate spot surrounding an ocellus on each side and extending almost to anterior margin and with a small yellow spot behind each at base. Pronotum black, with a yellow stripe on each side seeming like an extension of markings on crown, each stripe widened at middle and curved to lateral margins at humeral angles, with a small yellow spot behind each eye. Scutellum yellow, with a black transverse band occupying median portion and having a median longitudinal extension directed toward apex. Fore wings pale, with dark veins and basal claval area, corium, a small spot on costa opposite apex of clavus, and apical cells smoky brown.

Genitalia: Male (Fig. 8a–f) with plates short, broad, blunt at apex. Style slightly constricted at about middle, apical portion tapered to form a short blunt tube-like area. Aedeagus short, tubular, appearing gradually broadened, in ventral view, to a blunt apex; in lateral view, aedeagus broadened at middle, with a dorsal spine, then tapering to apex. Pygofer sloping to apex and bearing a prominent blunt spine.

Holotype male: Tumupasa, Bolivia, 1921–22 (W. M. Mann) Mulford Biol. Exploration. Holotype in the U. S. National Museum collection.

Gypona projecta, n. sp.

Resembling *glauca* in form, appearance, and coloration, and in genitalia closely related to *stylata*. Length of male 11 mm.

Crown broadly rounded, almost twice as wide at base as median length. Pronotum almost twice as long as crown.

Color: Crown, pronotum, and scutellum pale yellow. Crown with anterior margin brown. Pronotum with a pair of small round dark spots, one on either side at half the length of pronotum. Fore wings pale, with veins of clavus and corium, apical cells, and apical veins brown.

Genitalia: Male (Fig. 9a–f) with plates broadened apically and broadly rounded. Style narrow and elongate, with apical portion long, tapered, and curved dorsally. Aedeagus with shaft equal in length to basal portion, apex of shaft narrowed and with two pairs of apical processes (apical pair short and extending basally; basal pair long, slender, curved, and extending nearly to base of shaft). Pygofer elongate and bearing a small apical spur.

Holotype male: Tingo Maria, Huan, Peru, 21 Oct. 1946, at 2200 ft. elevation, J. C. Pallister. Holotype in the American Museum collection, New York City.

Gypona gemina, n. sp.

Resembling *glauca* in form and appearance, but smaller and with pale markings. Length of male 11 mm.

Crown broad, broadly rounded, almost twice as wide between eyes at base as median length.

Color: Crown, pronotum, and scutellum yellow, unmarked except for dark anterior margin of crown. Fore wings yellow, with clavus and apical cells smoky brown and costal area broadly pale.

Genitalia: Male (Fig. 10a–f) with plates broad apically and almost truncate on apical margin. Style long, rather narrow, enlarged just before apex, then narrowed and prolonged to form a long narrow spine-like apex. Aedeagus with shaft rather broad and bearing two pairs of proximal, very short processes which arise from ventral side near apex and extend outwardly. Pygofer without an apical spur.

Holotype male: Los Juntas, Bolivia, December, 1913, Ac. 5066. Holotype in the Steinbach collection, Carnegie Museum, Pittsburgh, Pennsylvania.

Gypona glauca (Fabricius)

Cercopis glauca Fabricius, 1803, p. 91.
Gypona glauca (Fabricius), 1803 (in Germar, 1821, p. 73).

A broad-headed species with anterior margin of head foliaceous, and with base of fore wings marked with black. Length of male 12 mm.

Crown flat, almost twice as broad as median length, with anterior margin roundedly produced and foliaceous. Ocelli nearer median line than eyes. Pronotum more than twice as long as crown.

Color: Crown, pronotum, and scutellum (Figs. 1 and 2) golden yellow. Fore wings (Fig. 1) yellow; with basal third of claval area dark brown, claval and discal veins brown, apex smoky brown.

Genitalia: Male (Fig. 11a–e) with plates rather broad, convexly curved on inner margin, apical margin sloping to a rounded, produced apex on outer edge. Styles enlarged and bent at right angle near middle, apical portion tapered to a pointed apex and directed dorsally. Aedeagus broad at base, concavely constricted before apex which is slightly enlarged, then tapered to a pointed, produced tip; at base of narrow apex a pair of long, narrow processes arise, these curving anteriorly then caudally with tips extending beyond central portion of shaft.

Notes: The holotype is labeled "Amer. merid. Schmidt. Mus. Sch. et. T. L. Glauca F." There are two identical males in the type series in the University Museum collection, Copenhagen. Both were studied and the genital structures of the holotype are illustrated. Only one other specimen has been identified as *glauca,* and this is a male in the Vienna Museum collection labeled "Bahia, Brazilia, Fruhstorfer."

Gypona stalina, n. sp.

Resembling *stalii* in form and general appearance and previously described as the male of *stalii.* Length of male 9.5 mm.

Crown broadly rounded, almost two-thirds as long at middle as basal width between eyes. Pronotum almost twice as long as crown.

Color: Crown pale yellow, with anterior margin black. Pronotum with a pair of round black spots, one on each side behind eye anterior to middle of pronotum. Scutellum pale. Fore wings pale; with basal half, tip of clavus, discal area, and apical cells brown.

Genitalia: Male (Fig. 12a–f) with plates rather short, convexly curved on outer margin, broadest at middle. Style elongate, broadest near base, tapered to a bluntly pointed apex. Aedeagus broad at base, appearing incised near base to form a long ventral process which is tapered on apical half to a pointed apex, a dorsal process which is about half as long as ventral process, concavely curved on dorsal margin and rapidly narrowed to a slender pointed apex.

Holotype male: Nova Teutonia, Santa Catarina, Brazil, 2 Oct. 1952. Paratype males: many specimens from same locality as holotype, 2 Oct. 1952; October and November, 1953; December 1943;

8 Jan. 1951; November and December, 1951; 27 Nov. 1952; and 10 Dec. 1952. Holotype and paratypes in the North Carolina State College collection.

Other specimens examined but not included in the type series are: A male in the Vienna Museum collection labeled "Fiebrig, Paraguay, S. Bernardino"; and the two paratype males of *stalii* in the Stockholm Museum collection, one labeled "Sao Loapolos" and the other labeled "Argentina." These paratype males and the type females of *stalii* are from widely separated localities and are apparently different species.

Gypona duella, n. sp.

A small species resembling *cerea* in general appearance but with basal clavus darker and male genitalia distinct. Length of male 10 mm.

Crown well produced, broadly rounded, almost two-thirds as long at middle as basal width between eyes, and about two-thirds as long as pronotum.

Color: Crown dark brown with a pair of small pale spots on base, one just behind each red ocellus. Pronotum and scutellum brown, unmarked. Fore wings pale; with anterior half of clavus dark brown; with veins of clavus, corium, and apical half brown.

Genitalia: Male (Fig. 13a–f) rather short, broadened at middle. Style elongate, rather narrow, in ventral view appearing narrowed on apical half. Aedeagus consisting of two long, slender, spine-like processes which are separated at base; base with spur extending dorsally. Pygofer tapered on apical half with a blunt portion projecting at apex.

Holotype male: Tucuman, Argentina, 21 May 1927 (Max Kisluik). A label on the pin reads "A specimen identical to this in Berge Collection is labeled *Gypona glauca* (Flor.)." Holotype in the U. S. National Museum collection.

Gypona postica Walker

Gypona postica Walker, 1858, p. 258.
Gypona marginata Walker, 1851, p. 838 (name preoccupied).

A small robust species related to *robusta.* Length of male 10 mm.

Crown broadly rounded, almost two-thirds as long at middle as basal width between eyes, anterior margin thin. Ocelli nearer to each other than to eyes.

Color: Yellowish. Anterior margin of crown reddish-brown.

Fore wings with claval area darker next to scutellum; veins dark brown to black, conspicuous.

Genitalia: Male (Fig. 14a-f) with plates three times as long as broad and broadly rounded at apex. Style elongate, rather thick, narrowed just before enlargement, with blunt apex which is curved inwardly; in ventral view, appearing definitely broadened at middle, with apex narrow. Aedeagus quite broad at base, concavely narrowed on dorsal margin to form a short dorsal process separated by a deep narrow notch from a long slender ventral process which tapers to a pointed apex. Pygofer with a broad, blunt, spine-like process on dorsocaudal margin.

Notes: This species was originally described by Walker in 1851 under the name *marginata.* The name *marginata* had already been used by Burmeister in 1787 when he described *Cercopis marginata.* Walker then redescribed this species in 1858 under the name *Gypona postica* which should remain as the proper name of this species.

The type series consists of five male specimens in the British Museum collection from Mexico, M. Salle Collection. Other male specimens which were examined are from Rio Frio, Colombia, March 1924 (W. M. Mann), and Summit, Panama, C. Z., 1947 (N. L. H. Krauss), in the U. S. National Museum collection.

Gypona fuscinervis Stal

Gypona fuscinervis Stal, 1864, p. 84.

Resembling *stalii* in general form and appearance but with lighter markings on wings. Length of male 9 mm.

Crown broadly rounded in front, more than two-thirds as wide between eyes at base as median length, with anterior margin thin.

Color: Crown, pronotum, and scutellum bright yellow, anterior margin of crown reddish. Fore wings yellowish, transparent, with veins brown.

Genitalia: Male (Fig. 15a–f) with plate short, broadened at middle, with a bluntly constricted apex. Style slender, tapered, bent at apex. Aedeagus large at base, then tapering to form two procesess which are closely compressed; ventral process long, narrow, tapered to a sharp pointed apex; dorsal process less than half as long as ventral process, tapered but blunt at apex. Pygofer narrowed at apex and bearing a blunt spur-like process.

Notes: The holotype male is from Vera Cruz, Mexico. There are no other specimens in the type series. Two other males with the type are also this species. Other specimens which were examined are: A male specimen from Tegucigalpa, Honduras, 2 Feb. 1918 (F. J. Dyar), in the U. S. National Museum collection; and a male specimen from Rio Metlac, near El Fortin, Vera Cruz, Mexico, 19 Dec. 1948, in the California University collection.

Gypona tubulata, n. sp.

Resembling *glauca* in form and coloration but with distinct genitalia. Length of male 12 mm.

Crown flat, broad, broadly rounded in front, width between eyes at base almost twice median length, with anterior margin thin and foliaceous.

Color: Dull yellowish marked with red and brown. Anterior margin of crown, ocelli, a pair of longitudinal stripes extending from ocelli across pronotum to apex of scutellum, and lateral margins of pronotum red. Fore wings yellow; with basal half of clavus, claval veins, apical cells and veins, and distal veins brown.

Genitalia: Female seventh sternite with produced lateral angles between which posterior margin is broadly and concavely rounded on each side to a produced lobe, between-lobes margin deeply excavated forming a V-shaped notch which extends half way to base. Male (Fig. 16a–d, f) with plates short, blunt, broad at apex. Styles long, slender, curved upward on apical third, blade-like, and tapered to a pointed apex. Aedeagus short, almost straight, tubular, without processes. Pygofer bearing a short blunt apical spine.

Holotype male: Napo R., Peru, 20 July 1946 (J. G. Sanders). Allotype female: Stipo, Janja Prov., Peru, October, 1945 (P. Paprzycki) (Donor F. Johnson). Paratypes: One female, same data as allotype; one male, Iquitos, Peru 11 Feb. 1924, F. 6062 (H. Bassler), Ac. 33591. Holotype and paratype female in the DeLong collection. Allotype and paratype male in the American Museum collection, New York.

Gypona funalis, n. sp.

A brown species, in general appearance resembling *cerea* but with distinct male genitalia. Length of male 9 mm.

Crown rather short, broadly rounded, almost twice as wide between eyes at base as median length.

Color: Crown brown, with a reddish line on anterior margin. Ocelli red. Pronotum and scutellum brown. Fore wings subhyaline, with dark veins.

Genitalia: Male (Fig. 17a–f) with plate broadest at about two-thirds its length, apex rounded. Style rather short, broad, apex truncate, with a thumb-like process on laterodorsal margin just before apex. Aedeagus consisting of a long slender shaft arising from a broad base, with a proximal process more than half as long as shaft, produced parallel to shaft and tapered to a slender apex. Pygofer short, broad, without an apical spur.

Holotype male: Labeled "Guyane Maroni" without specific data. Holotype in the North Carolina State College collection.

Gypona cerea, n. sp.

A small dark species resembling *melanota* in general appearance. Length of male 9.5 mm.

Crown well produced but broadly rounded, about two-thirds as long at middle as basal width between eyes.

Color: Dark brown to black. Crown rugose, usually darker than pronotum, neither of which have specific markings. Ocelli red. Scutellum with a light spot on each side near middle. Fore wings pale, subhyaline, with dark veins.

Genitalia: Male (Fig. 18a–f) with plate rather short, broadened, blunt at apex. Style long, slightly constricted just before apical portion which is deeply and broadly notched so as to form a mitten-like apex. Aedeagus composed of two long slender processes, with ventral process almost twice as long as dorsal process, distinctly separated at base. Pygofer bearing a blunt spur at apex.

Holotype male: Mafra, St. Cath., Brazil, Dec., 1935 (A. Miller) (Donor F. Johnson). Paratype: One male from Sao Paulo, Brazil, 12 April 1936 (E. J. Hambleton). Holotype in the North Carolina State College collection, and paratype in the U. S. National Museum collection.

Gypona clava, n. sp.

Resembling *glauca* in form but with a more intense coloration. Length of male 10 mm.

Crown broad, roundedly produced, twice as wide between eyes at base as median length.

Color: Crown, pronotum, and scutellum yellow with dark markings. Crown with anterior margin broadly black, a broad median longitudinal black stripe between ocelli extending onto anterior portion of pronotum, and a black spot next each eye at base. Pronotum with anterior and lateral margins black, with anterior central portion occupied by a rather broad black area from which a line extends posteriorly on each side then curves to posterior margin near humeral angles. Scutellum with a broad median black spot on anterior margin. Fore wings pale, basal half of clavus and apical cells smoky; veins of clavus and corium dark.

Genitalia: Male (Fig. 19a–f) with plate short, broadest at middle, apices blunt and truncate. Style broadened at middle, constricted just before apex, then bent at right angles to shaft and tapered to a rather long pointed apex. Aedeagus short, tubular, with base broad and shaft curved dorsally and narrowed to form a blunt apex with a short tooth projecting dorsally on inner margin. Pygofer bearing a short blunt spur at apex.

Holotype male: Labeled "St. Jean da Maroni, Cuyane Franc, collection L. E. Moult." Holotype in the North Carolina State College collection.

Gypona lugubrina Spangberg

Gypona lugubrina Spangberg, 1878, p. 13.
Gypona tristis Spangberg, 1878, p. 14 (*new synonymy*).

Form and general appearance resembling *stalii.* Length of male 9 mm.

Crown broadly rounded, less than twice as wide between eyes at base as median length. Pronotum almost twice as long as crown.

Color: Crown, pronotum, and scutellum yellowish. Crown with a faint black line on anterior margin. Fore wings yellowish; basal half of clavus embrowned; claval veins and veins on disk brown; apical cells embrowned.

Genitalia: Male (Fig. 20a–f) with plates short, broad, apices rounded. Styles long, rather slender, tapered to a long pointed apex with a tooth on outer margin not far from apex, may appear folded upon itself. Aedeagus short, simple in structure, tapering from base to a rather narrow tubular apex; apex appearing to be enveloped by basal portion. Pygofer constricted either side.

Notes: The holotype is from Bogota, Colombia. This is the only specimen in the type series. No females are known. The type specimen of *tristis* is identical with the type of *lugubrina* and is therefore placed as a synonym of *lugubrina.*

Gypona kjellanderi, n. sp.

Form, general appearance, and coloration resembling *lugubrina.* Length of male 8 mm.

Crown broadly rounded on anterior margin, with width between eyes not quite twice median length. Pronotum almost twice as long as crown.

Color: Crown, pronotum, and scutellum yellowish. Anterior margin of crown with a narrow black line. Fore wings yellowish; with anterior half of claval area, claval veins, veins of corium, and apical cells brown.

Genitalia: Male (Fig. 21a–f) with plates short, broad, with inner margin sloping to rounded apices. Style constricted at about two-thirds its length to form a slender prolonged apical tip. Aedeagus tubular, curved upward on apical forth and arising from a sheath-like basal portion, with apex blunt. Pygofer triangular.

Holotype male: Labeled "Bogota" and also previously labeled as a paratype of *tristis* Spangberg. Paratype: One male labeled the same as the holotype. Holotype and paratype in the Stockholm Museum collection.

The authors take pleasure in naming this species for Dr. Eric Kjellander who has aided this study so much by permitting the use of the Spangberg and Stal types.

Gypona vulnerata Walker

Gypona vulnerata Walker, 1858, p. 102.
Gypona viridescens Walker, 1858, p. 257.

A robust species related to *postica,* without conspicuous markings. Length of female 11.5 mm.

Crown rather short, broadly and roundedly produced, almost twice as broad between eyes at base as median length. Ocelli closer to median line than to eyes. Pronotum sloping, with produced humeral angles.

Color: Yellow. Crown with anterior margin darkened. Fore wings with basal half of clavus brownish.

Genitalia: Female seventh sternite (Fig. 22) with lateral angles broadly rounded; between these angles posterior margin slightly emarginate to a median broad V-shaped notch of about one-fourth width of segment and extending two-thirds distance to base, narrowed at apex and slightly rounded.

Notes: A single female holotype represents this species, and according to the original description is from Brazil.

Gypona plana Walker

Gypona plana Walker, 1858, p. 101.

Closely related to *glauca* but with less coloration. Length of female 13 mm.

Crown broadly and roundedly produced, more than twice as wide as median length, with anterior margin thin and foliaceous. Ocelli slightly closer to each other than to eyes.

Color: Pale yellow. Crown and scutellum unmarked. Pronotum with disc and posterior portion dark. Fore wings with basal half of clavus, a spot about middle of wing, and apical portion brown.

Genitalia: Female seventh sternite (Fig. 23) with prominent lateral angles, between which posterior margin rather deeply and concavely excavated to form a pair of produced blunt teeth at apex, these separated by a U-shaped notch.

Notes: A single female holotype represents this species, and there is no data on the pin.

Gypona obesa Spangberg

Gypona obesa Spangberg, 1883, p. 102.

A pale, rather broad species related to *bimaculata.* Length of female 12 mm.

Crown broadly rounded, less than two-thirds as long at middle as basal width between eyes, with anterior margin thin. Ocelli closer to median line than to eyes.

Color: Pale yellow. Crown with anterior margin red. Fore wings with veins on basal half of clavus broadly dark brown, with a spot on clavus next to apex of scutellum and veins on apical half of wing brown.

Genitalia: Female seventh sternite (Fig. 24) with well-produced rounded lateral angles, between which posterior margin slightly and concavely rounded either side of a deep, broad, median V-shaped notch extending almost to base of sternite.

Notes: This species is represented by a single female holotype from Mexico in the Vienna Natural History Museum collection. The data on the pin is "Bilimek, Mexico, 1871, Orizaba."

Gypona signifera Walker

Gypona signifera Walker, 1851, p. 836.

A rather robust species with a short blunt head. Length of female 10 mm.

Crown short, broadly rounded, almost twice as broad as median length, with anterior margin thin but not foliaceous. Ocelli closer to each other than to eyes.

Color: Dull yellow, without markings. Veins on central portion of fore wings and anteapical veins brown.

Genitalia: Female seventh sternite (Fig. 25) with lateral angles produced and angled at apex; posterior margin between lateral angles deeply and concavely excavated to form a U-shaped notch at apex.

Notes: The female holotype is from Venezuela but there is no label on the specimen. No other specimens are known.

Gypona viridirufa Walker

Gypona viridirufa Walker, 1851, p. 836.
Gypona quadrimacula Walker, 1851, p. 837 (*new synonymy*).

Related to *glauca* with similar but fainter color markings. Length of female 12 mm.

Crown roundedly produced, flat, more than twice as wide as long, with anterior margin thin.

Color: Green tinged with yellow. Anterior margin of crown red. Fore wings green, dark at base, with brown apices.

Genitalia: Female seventh sternite (Fig. 26) with produced and rounded lateral angles, between which posterior margin rather broadly and concavely excavated either side of a V-shaped notch which extends more than half way to base.

Notes: This species is represented by a single female holotype from Paraguay (Mr. Stevens Collection). When a series of specimens is available, this may prove to be a synonym. At present it is placed under the name *glauca* in the British Museum collection. *G. quadrimacula* Walker was also described from a single specimen from Paraguay. This specimen is darker in color but closely resembles *viridirufa.* It has no abdomen and even if present when collected the sex was not named nor the sex characters described. *G. quadrimaculata* is therefore placed as a synonym of *viridirufa.*

Gypona prolongata, n. sp.

Resembling *glauca* in form and general appearance but with coloration of fore wings confined to apical portion. Length of female 12 mm.

Crown broadly rounded, more than half as long at middle as basal width between eyes, with anterior margin thin and foliaceous.

Color: Pale yellow marked with brown. Crown yellowish, with anterior margin marked with a narrow black line margined with red above. Ocelli red. Pronotum pale, with median posterior half darker. Scutellum dark. Fore wings pale, subhyaline, with tip of clavus and apical cells marked with brown. Abdomen dark, showing through claval area of fore wings.

Genitalia: Female seventh sternite (Fig. 29) with narrowly produced lateral angles, between which posterior margin concavely excavated either side of a pair of rounded and slightly produced lobes which border a median, broad, brown bordered U-shaped notch extending almost two-thirds distance to base.

Holotype female: Huanuce, Peru, March, 1947, 2000 m. (Weyrauch). Holotype in the U. S. National Museum collection.

Gypona glaucina Spangberg

Gypona glaucina Spangberg, 1878, p. 16.

Resembling *stalii* in form, coloration, and size. Length of female 13 mm.

Crown short, broad, twice as wide between eyes at base as median length, with anterior margin thin and foliaceous.

Color: Crown, pronotum, and scutellum yellowish. Fore wings yellow; with clavus brownish, especially basal half; with apical cells mottled with brown.

Genitalia: Female seventh sternite (Fig. 30) broadly excavated between lateral angles, with a produced portion either side of a median deeply excavated V-shaped notch.

Notes: The single holotype female is from Brazil. No other specimens have been observed.

Gypona stalii Spangberg

Gypona stalii Spangberg, 1878, p. 317.

A large, well marked species, pale in color with brownish markings. Length of female 13 mm.

Crown broad, about twice as wide between eyes at base as median length, with anterior margin thin and foliaceous. Pronotum longer than crown.

Color: Crown, pronotum, and scutellum yellow without markings. Fore wings with clavus dark brown, costal area yellowish, apical cells mottled with brown. Under face and venter yellowish.

Genitalia: Female seventh sternite (Fig. 31) broadly and rather deeply concave, with lateral angles prominent, middle with a rather deep U-shaped notch margined with brown.

Notes: The female holotype is marked "Brazil." There are also two female paratypes, one marked "Brazil," and the other marked "Rio Janeiro." The types are in the Stockholm Museum. Other specimens examined are: Three females from Brazil in the Signoret Collection in the Vienna Museum collection.

Gypona affinis Spangberg

Gypona affinis Spanberg, 1878, p. 17.

Appearing as a pale specimen of *glaucina* with shape and color very similar, but with different female genital structures. Length of female 13 mm.

Crown broadly rounded, twice as wide between eyes at base as median length. Pronotum twice as long as crown.

Color: Crown, pronotum, and scutellum yellowish. Crown with anterior margin marked with reddish. Fore wings yellow, with clavus pale brown, especially basal portion, and apical cells clouded with brown.

Genitalia: Female seventh sternite (Fig. 32) concave between lateral angles and a pair of produced lobes, with lobes widely separated by a broad and deep excavation running more than half distance to base, with apical portion of excavation producing a V-shaped notch.

Notes: This species is known only from the female holotype labeled "Brazil, type" and in the Stockholm Museum collection.

Gypona pinguis Stal

Gypona pinguis Stal, 1862, p. 46.

General appearance resembles *brevipennis* Length of female 10 mm.

Crown broadly rounded, flattened anteriorly, width between eyes at base less than twice median length. Pronotum less than twice as long as crown.

Color: Crown, pronotum, and scutellum yellowish. Scutellum with slightly darker mottling upon disk and basal angles. Fore wings yellowish, subhyaline, veins not conspicuous, apical portion slightly brownish.

Genitalia: Female seventh sternite (Fig. 33) almost truncate, with a broad U-shaped notch at center extending half way to base, with apical portion of notch slightly embrowned.

Notes: This species is represented by a single female holotype which is labeled "Brazil." No other specimens have been examined which belong to this species.

Gypona assimilis Spangberg

Gypona assimilis Spangberg, 1878, p. 16.

Form and general appearance resembling *stalii* but female seventh sternite different. Length of female 13 mm.

Crown broadly rounded, about one and one-half times as wide between eyes at base as median length, with anterior margin thin and foliaceous.

Color: Crown, pronotum, and scutellum yellowish. Anterior margin of crown red. Pronotum with red on either side. Fore wings yellowish, with veins of posterior half and basal half of clavus brown and apical cells marked with brown.

Genitalia: Female seventh sternite (Fig. 34) rather broadly excavated between lateral angles and projected lobes either side of a median broad V-shaped notch which extends more than half way to base.

Notes: This species is represented by two female specimens in the Stockholm Museum collection, one marked "Bogota," and the other labeled "Perou." No other specimens have been identified as this species.

Gypona bidens, n. sp.

Resembling *stalli* in form and general appearance but smaller, with distinct female seventh sternite. Length of female 12.5 mm.

Crown broadly rounded, almost twice as broad between eyes at base as median length, with anterior margin thin.

Color: Crown, pronotum, and scutellum pale brownish yellow, unmarked. Fore wings yellowish, subhyaline; with claval area brown, apical cells marked with brown, and veins on corium heavily embrowned.

Genitalia: Female seventh sternite (Fig. 35) with prominent lateral angles, between which posterior margin rather deeply and concavely excavated, then produced into a pair of pointed processes either side of a deep, narrow, U-shaped, brown margined notch extending half way to base.

Holotype female: Labeled "Brasilien," without further data. This specimen was previously identified as *affinis* by Spangberg and is in the Vienna Museum collection.

Gypona excavata, n. sp.

Resembling *stalii* in general appearance but larger, banded more, and with a broad deeply excavated seventh sternite. Length of female 14 mm.

Crown broadly rounded, twice as wide between eyes at base as median length.

Color: Crown, pronotum, and scutellum pale yellow tinged with reddish brown. Anterior margin of crown black. Ocelli dark. Fore wings with basal half and apical portion of clavus brown, a transverse band across wings at apex of clavus dark apical cells pale brown.

Genitalia: Female seventh sternite (Fig. 36) with posterior margin produced forming a narrow projection either side of a broad, deep, median excavation; excavation extending almost to base of segment and half as wide as it is, with a small V-shaped notch at middle.

Holotype female: Squitos, Peru, May 18, 1944, J. G. Sanders. Paratype: One female from Iquitos, Peru, March–April 1931, R. C. Shannon. Holotype in the DeLong collection, and the paratype in the U. S. National Museum collection.

Notes: These two specimens do not seem to fit any of the described species in this complex. They differ by the extra band on the wings and the unusual pattern of the female segment.

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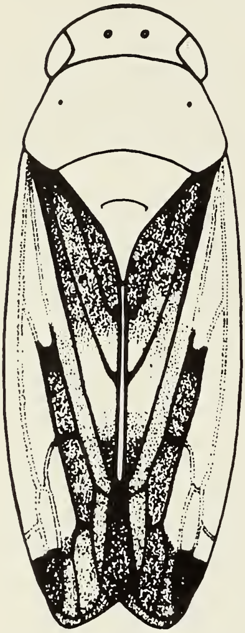
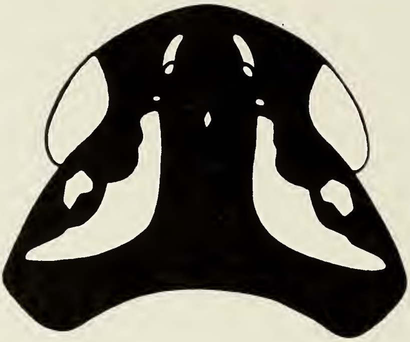
Plate I



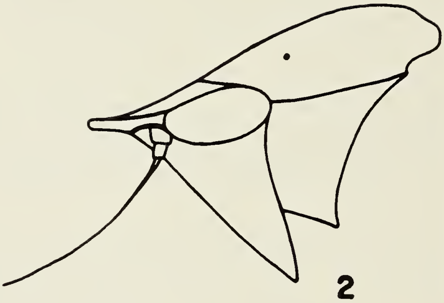
1

GLAUCA



3

OBSTINATA

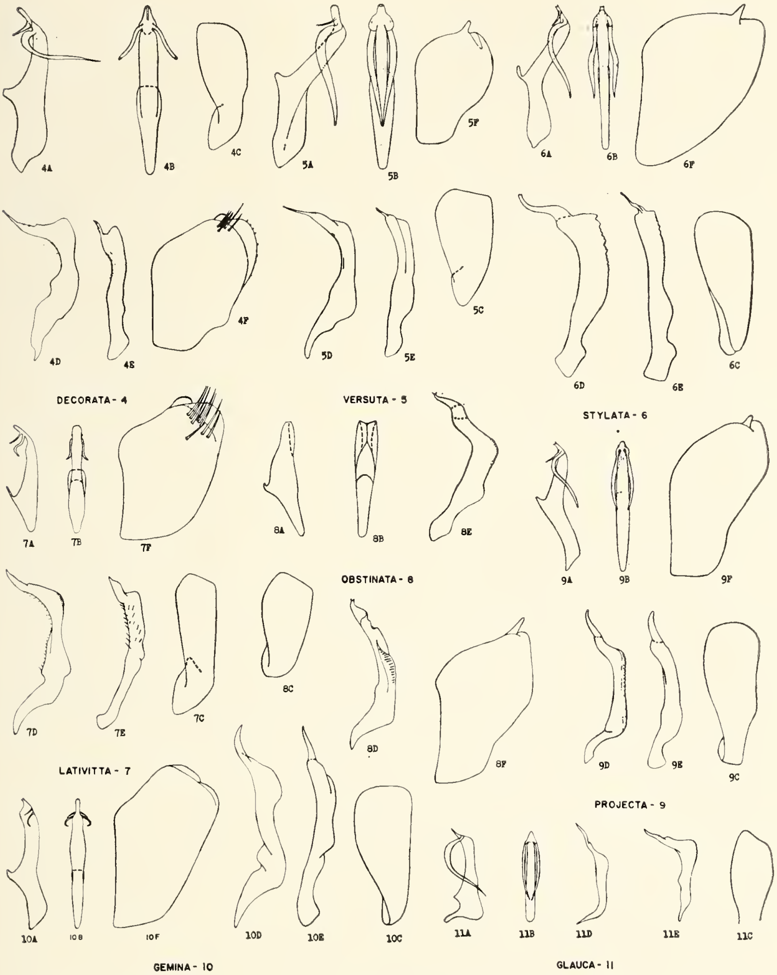


2

GLAUCA

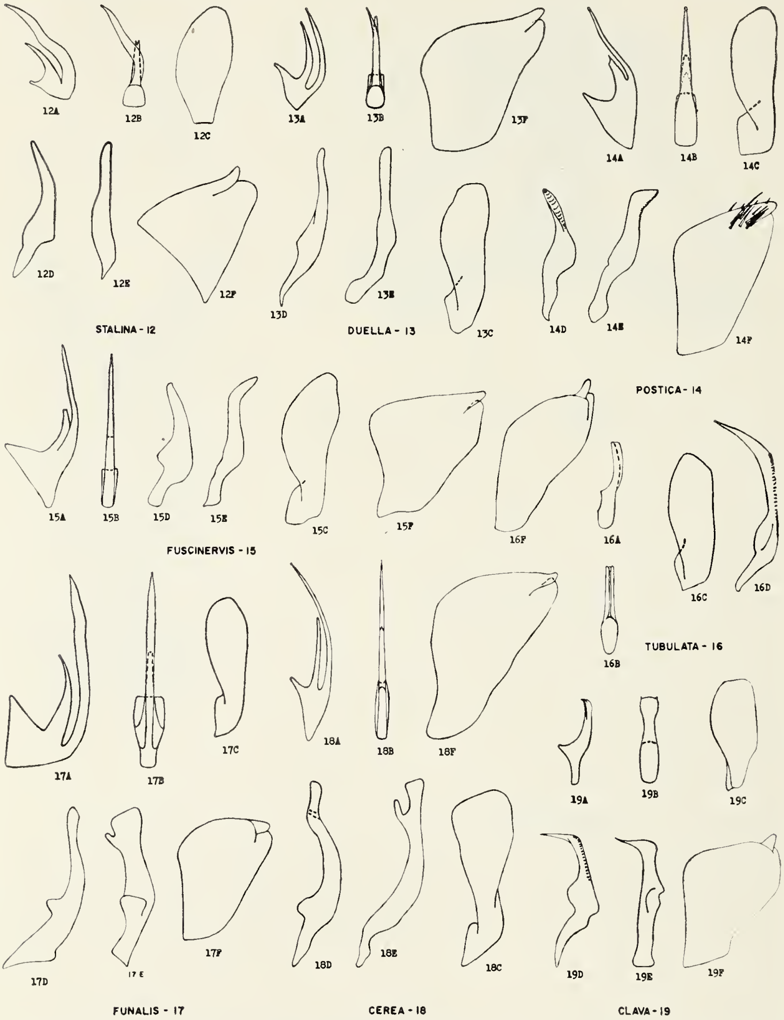
Figs. 1–2, *Gypona glauca* (Fabricius): 1, Dorsal view of male. 2, Lateral view of head and prothorax. Fig. 3, *Gypona obstinata*, n. sp., dorsal view of head and prothorax.

DeLong and Freytag Plate II


4A
4B
4C
5A
5B
5F
6A
6B
6F
4D
4E
4F
5D
5E
5C
6D
6E
6C
DECORATA - 4
VERSUTA - 5
STYLATA - 6
7A
7B
7F
8A
8B
8E
9A
9B
9F
OBSTINATA - 8
7D
7E
7C
8C
8D
8F
9D
9E
9C
LATIVITTA - 7
PROJECTA - 9
10A
10B
10F
10D
10E
10C
11A
11B
11D
11E
11C
GEMINA - 10
GLAUCA - 11

Figs. 4–11, The male genital structures of various species of *Gypona:* 4, *G. decorata* Fowler. 5, *G. versuta* Spangberg. 6, *G. stylata,* n. sp. 7, *G. lativitta* Walker. 8, *G. obstinata,* n. sp. 9, *G. projecta,* n. sp. 10, *G. gemina,* n. sp. 11, *G. glauca* (Fabricius). Showing: A, lateral view of aedeagus; B, ventral view of aedeagus; C, ventral view of plate; D, ventral view of style; E, lateral view of style; F, lateral view of pygofer.

DeLong and Freytag Plate III


12A
12B
12C
13A
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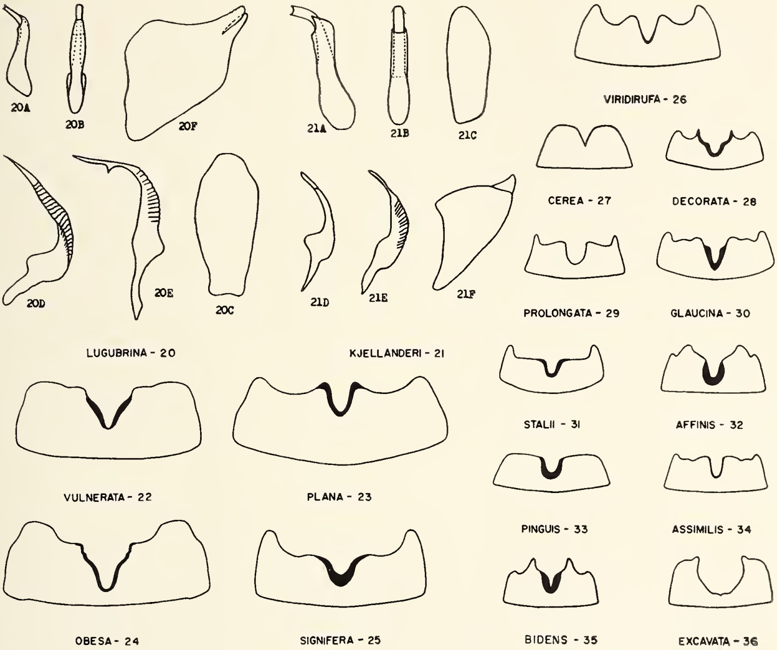
13F
14A
14B
14C
12D
12E
12F
13D
13E
13C
14D
14E
14F
STALINA - 12
DUELLA - 13
POSTICA - 14
15A
15B
15D
15E
15C
15F
16F
16A
16C
16D
FUSCINERVIS - 15
TUBULATA - 16
17A
17B
17C
18A
18B
18F
16B
19A
19B
19C
17D
17E
17F
18D
18E
18C
19D
19E
19F
FUNALIS - 17
CEREA - 18
CLAVA - 19

Figs. 12–19, The male genital structures of various species of *Gypona:* 12, *G. stalina,* n. sp. 13, *G. duella,* n. sp. 14, *G. postica* Walker. 15, *G. fuscinervis* Stal. 16, *G. tubulata,* n. sp. 17. *G. funalis,* n. sp. 18, *G. cerea,* n. sp. 19, *G. clava,* n. sp. Showing: A, lateral view of aedeagus; B, ventral view of aedeagus; C, ventral view of plate; D, ventral view of style; E, lateral view of style; F, lateral view of pygofer.

DeLong and Freytag

Plate IV


20A
20B
20F
21A
21B
21C
VIRIDIRUFA - 26
CEREA - 27
DECORATA - 28
20D
20E
20C
21D
21E
21F
PROLONGATA - 29
GLAUCINA - 30
LUGUBRINA - 20
KJELLANDERI - 21
STALII - 31
AFFINIS - 32
VULNERATA - 22
PLANA - 23
PINGUIS - 33
ASSIMILIS - 34
OBESA - 24
SIGNIFERA - 25
BIDENS - 35
EXCAVATA - 36

Figs. 20–21, The male genital structures of various species of *Gypona:* 20, *lugubrina* Spangberg. 21, *G. kjellanderi,* n. sp. Showing: A, lateral view of aedeagus; B, ventral view of aedeagus; C, ventral view of plate; D, ventral view of style; E, lateral view of style; F, lateral view of pygofer. Figs. 22–36, The female seventh sternite of various species of *Gypona: 22, G. vulnerata* Walker. 23, *G. plana* Walker. 24, *G. obesa* Spangberg. 25, *G. signifera* Walker. 26, *G. viridirufa* Walker. 27, *G. cerea,* n. sp. 28, *G. decorata* Fowler. 29, *G. prolongata,* n. sp. 30, *G. glaucina* Spangberg. 31, *G. stalii* Spangberg. 32, *G. affinis* Spangberg. 33, *G. pinguis* Stal. 34, *G. assimilis* Spangberg. 35, *G. bidens,* n. sp. 36, *G. excavata,* n. sp.

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BULLETIN

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STUDIES ON THE PLECOPTERA OF NORTH AMERICA: X. GENITALIC VARIATIONS IN THE MALES OF *PARALEUCTRA*[1]

By John F. Hanson, Amherst, Mass.

The anatomical features of stoneflies that have been the least useful for distinguishing species, such as wing venation and female genitalia, are the ones that have been the most studied for variability. The male genitalia of different species are usually so different from one another that detailed studies of extremes of variation are rarely essential for species identification. In a few instances, however, where species are closely similar in the male sex as well as in the female or where hybridization may be occurring, it is imperative to have a knowledge of the amount and nature of the variation in male genitalia to clarify species status. For this purpose it is necessary, first of all, to study the variations in specimens from a single location. With this as a base, study of geographical variations is possible. Surprisingly, there are extremely few species of which enough specimens are available to justify making conclusions about the extent of variation in even one single location. And yet, we find in the literature a number of interpretations of geographical variation in Plecoptera. To further confuse the situation, some interpretations are based on inaccurate observations as well as on insufficient numbers of specimens. The whole subject of geographical variation in Plecoptera should be carefully reviewed.

In 1942 Frison published an interesting treatment of local and geographical variations in the specialized cerci of some species of

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[1] Contribution from The Massachusetts Agricultural Experiment Station and Contribution No. 1356 from the entomological laboratory of The University of Massachusetts. Supported by NIH Grant E-1442(C6), U.S. Public Health Service.

Paraleuctra. His work raised some difficult evolutionary and nomenclatorial problems one of which concerned the status of our single eastern species, *P. sara* (Claassen), and its relationship to one of the western "forms". It was Frison's opinion that with further collecting in critical geographic locations *P. sara* and what was then called *occidentalis,* following the usage in Needham and Claassen's monograph (1925), would be found to be a single geographically variable species.

Very shortly after receiving Frison's paper I studied my own specimens for the variations he described since I happened to have a series (nearly 300 males) of *P. sara* as well as a small number of *P. occidentalis auct.* I could not confirm either his observations or his conclusions. In 1946, after an opportunity to study all of the Illinois material of both forms, my judgement of Frison's paper remained unchanged. Thus, it seemed particularly unfortunate when Ricker, in 1954, without presenting any additional evidence, formally declared transcontinental conspecificity under the name of *sara.* It is difficult to understand why Frison (and later Ricker) did not prefer to question his own species, *forcipata* 1937, since it is, in both sexes, considerably more like the eastern *sara* than is *occidentalis auctores.*

A recent tussle with another problem of geographical variation has brought this case back to mind and I have exhumed my notes and specimens, after nearly two decades, for a renewed look at our differences of opinion. In consideration of the current interest in geographical variation as it relates to evolution and species taxonomy, a correction of Frison's observations and conclusions and of Ricker's nomenclatorial decision should no longer be delayed.

It is easy to see, with such an asymmetrical object as the cercus shown in the plate of shaded drawings, that slight changes in position could radically change the silhouette. Most of us, at one time or another, have a playfully created a similar variety of images with the shadow of a hand. In my current studies, to assure that there could be no question of my interpretations being due to such an effect, the cerci were dissected from the specimens and mounted on slides in identical positions. Fortunately this was very easy to do since the cercus, as it settles through the mounting medium, makes a three-point landing on the surface of the slide coming to rest on the tips of the two arms and the base of the cercus, thus giving a standardized lateral view. Assurance against distortion by pressure from the cover slip was obtained by supporting the cover slip on bits of cork thicker than the cerci.

Paraleuctra sara (Claassen)

Figs. 1, 3, 5, 6

Each cercus, dorsally, has a small notch at the very base (Fig. 1). The hind margin of the tenth tergite fits into this notch and against the flat anterior face of a conspicuous dorsal tooth at the edge of the notch. Two cone-shaped arms diverge posteromesally from the somewhat compressed basal area. Each arm has a small projection, the upper one being the more conspicuous not only because it is the larger but because it is located ventrally on the arm and thus its outline can be seen easily from lateral view: the projection on the lower arm, because it is on the mesal side, is hidden from the normal lateral view.

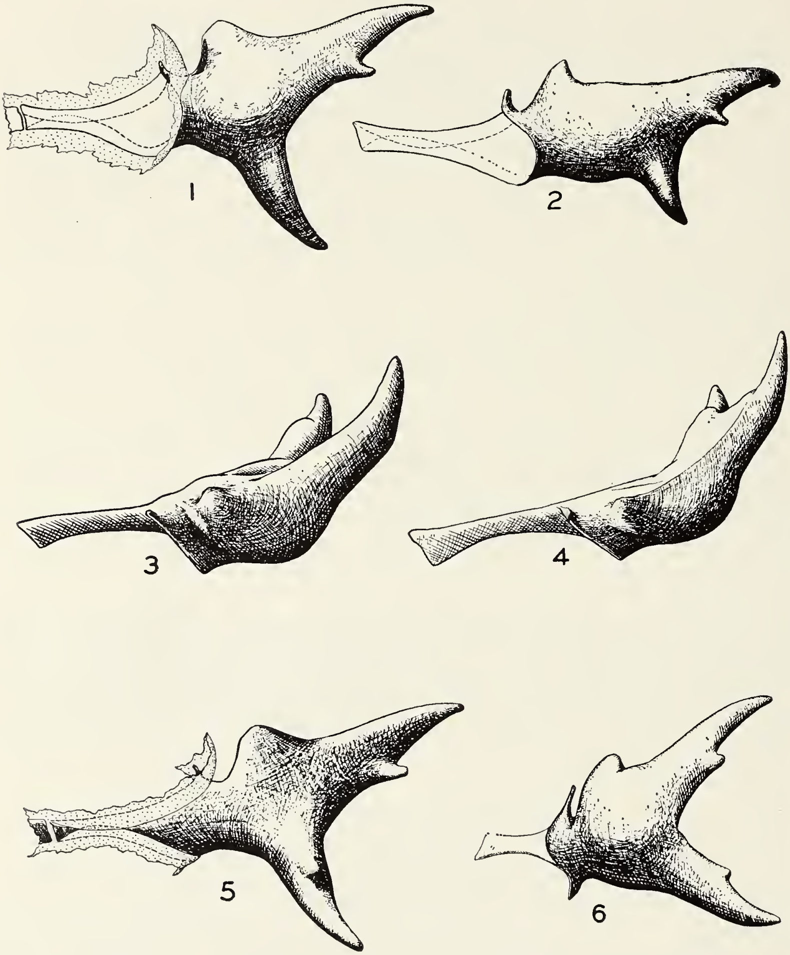
It is interesting to note that any single specimen in my collection can be held in such a position as essentially to duplicate each of the figures shown by Frison. For example, compare Figure 6, an oblique caudal view, with 7A. The outlines of 7B, 7C and 7D can be produced simply by observing the same cercus from progressively more anterior positions. 7F is produced by assuming a more nearly dorsal position of the observer, in which case the lower arm will appear relatively small as the bulk of this arm disappears under the upper arm.

A comparison of all of the specimens in my collection with the specimens used for the shaded drawings shows only minor variations in proportions when the specimens are carefully oriented into the identical lateral positions. Nothing approaching the extensive amount of variation which Frison reported (Fig. 7A–F) appears to exist in this species.

Paraleuctra occidentalis auct.

Figs. 2, 4

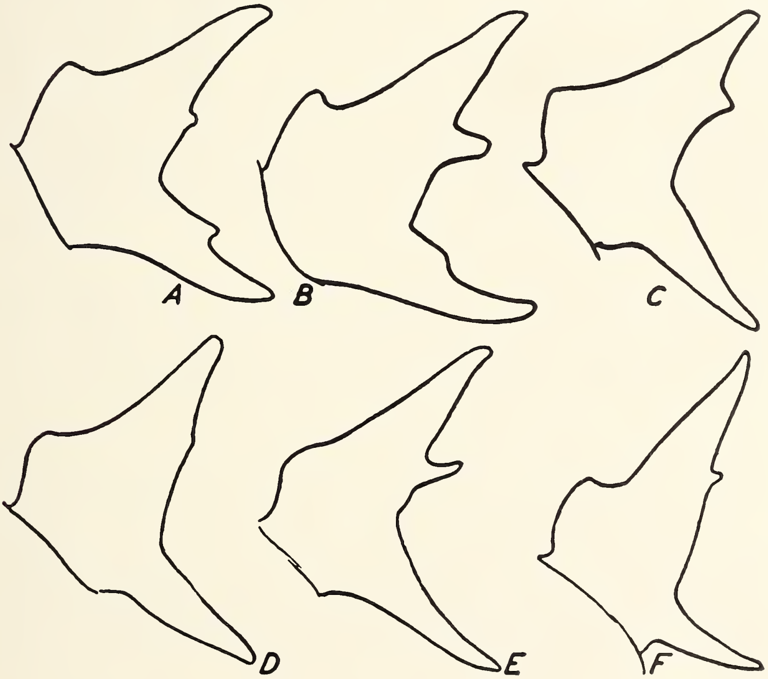
According to Ricker there are four type specimens of *occidentalis* (Banks). He found the two deposited in the United States National Museum to be two different species and thought that each was different from the single complete specimen at the Museum of Comparative Zoology at Harvard University. Since the latter, a female, agreed, he thought, with then current interpretation of *occidentalis* (Needham and Claassen, 1925), he designated it lectotype. He later discovered his mistake and was therefore obliged to synonymize Claassen's *bradleyi* under *occidentalis* (Banks). Since the abdomen of one of the types has long been missing, its identity will probably never be known. However, it seems unlikely that Claassen would have described *bradleyi* without first having



Male cerci of *Paraleuctra:* Figs. 1–2, Lateral views of *P. sara* and *P. occidentalis auct.*, respectively. Figs. 3–4, Dorsal views of *P. sara* and *P. occidentalis auct,* respectively. Fig. 5, Mesal view of *P. sara.* Fig. 6, Oblique latero-dorso-caudal view of *P. sara* to show the protuberances on both arms of the cercus simultaneously, as in Frison's drawing A. Fig. 7, (on opposite page), Variations in the cerci of *P. sara* claimed by Frison (from Frison, 1942) : A from Massachusetts, B from Indiana, C–F from Tennessee.

studied at least one of the four cotypes of *occidentalis* (Banks), and therefore it is probable that the abdomenless specimen is the *occidentalis* of Needham and Claassen (1925) and later authors. Because of the existing confusion, *P. occidentalis auct.* is left without a name. I plan to describe it as a new species in a later paper since the specific purpose of this paper is to discuss cercal variability.

Frison, in his 1942 paper, showed three figures of what he claimed were cercal variants of *occidentalis* from three different western states. In 1946 I studied the specimens concerned in the Illinois Survey Collection and I made the following notes. "Dr. Frison has done exactly the same with this species as with *sara* in demonstration of variability. I examined his specimens from Ore., Idaho, Colo., Calif., B. C., Wash., Mont., Wyo., including the ones used by Mohr for Frison's figs., 1942, p. 259, without finding the slightest indication of variation except in the process on the dorsal arm



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which is very small in some cases." To check this finding more carefully a series of uniform slide mounts of cerci of *P. occidentalis* from a wide geographic range (Oregon, Colorado, California, and Utah) was recently prepared. A study of these specimens substantiates my 1946 observations and therefore lends no support to Frison's contention that "The difference between *sara* and *occidentalis* are certainly slight, and there is reason to suspect that collecting in northern states and southern Canada will show that *sara* is specifically the same as *occidentalis*" (Frison, 1942, p. 260).

P. occidentalis auct. differs from *sara* in at least five distinct cercal features: (1) in *occidentalis* (Fig. 2) the length of the base of the cercus, measured laterally, is considerably longer than in any specimen of *sara* (Fig. 1); (2) the lower arm of the *occidentalis* cercus is much shorter, relative to the upper, than in *sara;* (3) the basal dorsal process is smaller and narrower in *occidentalis* than in *sara*, in lateral view; (4) the lower arm in *occidentalis* never bears a process while in *sara* it always does; (5) if carefully observed at the right angle with the right lighting, the mesal surface of the cercus of *occidentalis* (Fig. 4) is seen to be more nearly flat than that of *sara* (Fig. 3) and is angularly demarked from the dorsal surface along a line extending from the dorsal tooth onto the base of the dorsal arm. Considering the distinctness of the cerci indicated above, it is quite likely that further study will disclose additional genitalic differences useful in separating the two species.

ACKNOWLEDGEMENTS

I am indebted to Dr. E. I. Coher for his very critical reading of the manuscript and to two of my students for similar service. Mr. Joseph Pallazola is responsible not only for the fine shading on the drawings but contributed materially to their detailed accuracy.

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A NEW SPECIES OF *SYNANTHEDON* FROM OHIO (LEPIDOPTERA: AEGERIIDAE)

By Ronald W. Hodges[1]

A series of adults of an aegeriid was reared from *Viburnum opulus nanum* Jacq. by F. L. Gambrell of the New York State Agricultural Experiment Station; the specimens were submitted for identification by E. H. Smith of Cornell University. The species is near *Synanthedon viburni* Engelhardt; however, it differs from the latter in both larval and imaginal characters.

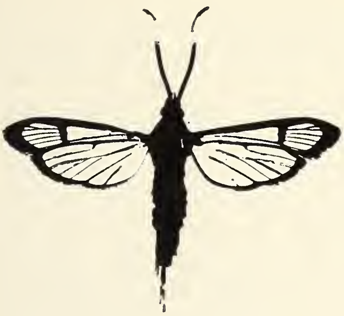

Fig. 1, *Synanthedon fatifera,* n. sp., paratype, female, Mentor, Ohio.

Synanthedon fatifera, n. sp.
(Figure 1)

Male. — Antenna blue-black with a few pale yellow scales at three-fourths, slightly dilated apically, a short apical tuft. Tongue well developed. Labial palpus blue-black on dorsal surface of first and second segment, third segment and lateral and ventral surfaces of first and second segments pale yellow. Head blue-black with a few pale yellow scales on face and occiput, pale yellow scales surrounding eye ventrally and posteriorly. Thorax shining blue-black, a dorso-lateral pale yellow line on mesothorax, a broad pale yellow band below wings on mesothorax and on anterior portion of metathorax, a few pale yellow scales on dorsal surface of metathorax. Forewings with veins blue-black, lightly dusted with pale yellow, dorsal margin heavily dusted with pale yellow scales; cilia dark fuscous. Hindwings with veins blue-black; $M_1 - M_{2+3}$ cross vein without scales; costal margin pale yellow to five-sixths, then blue-black; cilia dark fuscous, pale yellow at base. Ventral surface of prothoracic coxa blue-black broadly bordered laterally and distally with pale yellow; femur blue-black with pale yellow at apex; tibia blue-black medially, pale yellow laterally, epiplysis pale yellow; tarsus blue-black ven-

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[1] Entomology Research Division, Agricultural Research Service, U.S.D.A., Washington, D. C.

trally, yellow dorsally and at apices of first second, third and fifth segments. Metathoracic leg blue-black; tibia pale yellow at middle and apex; outer surface of tarsus pale yellow at apex of first, fourth, and fifth segments. Abdomen blue-black, a small lateral patch of pale yellow scales on first and fourth segments, anal tuft edged with pale yellow.

Male genitalia as in Figure 2 (R.W.H. slide no. 2001).

Alar expanse of male 17–19 mm.

Female.—Maculation as for male except that antenna is pale yellow from three-fifths nearly to apex.

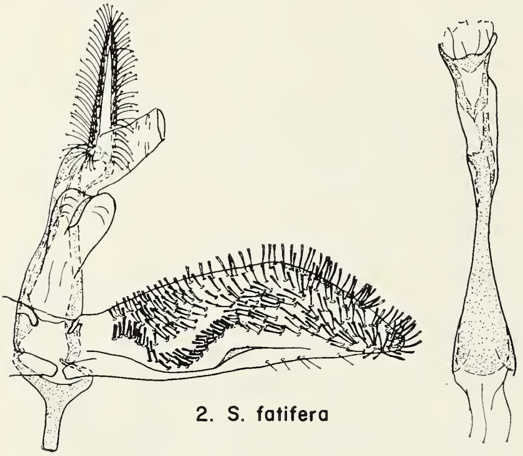
Female genitalia as in Figure 3 (R.W.H. slide no. 2002).

Alar expanse of female 20–22 mm.

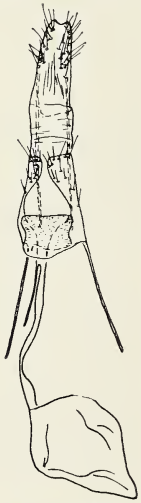
Food plant.—*Viburnum opulus nanum* Jacq.

Types.—Holotype: male, Mentor, Ohio, emerged at Geneva N. Y., July 13, 1961, *Viburnum;* E.H.S. 1–61; R.W.H. ♂ genitalia slide No. 2001 [U.S.N.M. Type No. 66024]. Paratypes: 1 ♂, 2 ♀, same locality as type, July 17–23, 1961 [U.S.N.M.]

Discussion.—The male of *Synanthedon fatifera* may be separated from that of *S. viburni* by the series of broad setae being roughly parallel to the sacculus ridge; in *viburni* the same series of setae crosses the sacculus ridge and runs to the ventral margin of the valva. The female genitalia of the two species are not separable. The most notable point of difference between the habitus of the two



2. S. fatifera



3. S. fatifera

Figs. 2 and 3, Ventral view of genitalia of *Synanthedon fatifera,* n. sp. Fig. 2, Male. Fig. 3, Female.

species is that *fatifera* lacks a dorsal yellow band on the posterior edge of the second abdominal segment, whereas a yellow band is present in *viburni.*

Mentor, Ohio, is the type locality of *fatifera.* However, the plants containing the larvae were shipped to Newark, New York. They were rejected by the New York State Horticultural Inspector at Newark because they were found to be infested with borers. At that time some of the plants were taken to Geneva for the purpose of rearing the insect.

CONCERNING SOME SPECIES OF *TENAGOGONUS S. STR.* (GERRIDAE: HEMIPTERA)[1]

By Herbert B. Hungerford and Ryuichi Matsuda

In 1958 we published "The *Tenagogonus-Limnometra* complex of the Gerridae" (Univ. Kansas Sci. Bul. 39(9): 371–457). While we combined both *Tenagogonus* Stål 1853 and *Limnometra* Mayr 1865 in a single key to species we considered them close but distinct genera. However, by 1960 we had decided that the above groups should more correctly be designated as *Tenagogonus* (*Tenagogonus*) Stål and *Tenagogonus* (*Limnometra*) Mayr (Univ. Kansas Sci. Bul. 41(1): 10). Several new species have come to our attention since then. We described *Tenagogonus* (*Tenagogonus*) *valentinei* from Fiji islands in 1961 (J. Kansas Ent. Soc. 34(4): 173–176). We describe two new species below.

Tenagogonus (Tenagogonus) ceylonensis, n. sp.
(Figs. F–I)

Size: Apterous male 5.33 mm. long; width of head across eyes 1.19 mm.; width of pronotum 1.05 mm.; width of body across mesoacetabula 1.81 mm. Apterous female 7.00 mm. long; width of head across eyes 1.35 mm.; width of pronotum 1.13 mm.; width of body across mesoacetabula 2.69 mm.

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[1] Contribution No. 1167 from the Department of Entomology, The University of Kansas. This study is a by-product of a research project aided by a grant from the National Science Foundation.

Color: The dark markings of the pattern are dark brown to black. Pronotum also has some fainter markings of light brown (Figs. F,G). Typically there is a distinct white spot on mesothorax anterior to caudolateral angle of pronotum. Mesonotum and venter nearly black.

Structural characteristics: Relative lengths of antennal segments: Male 1st:2nd:3rd:4th::62:48:80:90. Female 1st:2nd:3rd:4th::74:48:77:93.

Actual lengths of leg segments in mm.

	Femur	Tibia	First tarsal segment	Second tarsal segment
Front leg				
Male	2.21	2.00	0.19	0.31
Female	2.67	2.33	0.24	0.43
Middle leg				
Male	4.88	3.93	1.62	0.41
Female	5.95	4.76	1.83	0.43
Hind leg				
Male	4.83	2.17	0.45	0.29
Female	5.62	2.62	0.52	0.40

Male as seen from above without connexival spines, its seventh abdominal sternite without protuberances. Venter of first genital segment without a median longitudinal depression, its rear margin as shown in Fig. H. Pygofer relatively broad, its margin without lateral tufts of hairs. Parameres vestigial.

Female as seen from above shows connexival spines long and last abdominal sternite produced as shown in Fig. I.

Comparative notes: This species runs out in our key of 1958 to *T. fijiensis* Hungerford and Matsuda but it is not that species, because the color pattern is different and the distal margin of pronotum is not narrowed. In the male the median caudal projection of ventral rear margin of first genital segment is broader and more conspicuous than in *T. fijiensis.* In the female the last abdominal sternite is much shorter than in *T. fijiensis* and the connexival spines are longer and not flap-like as they are in the latter species.

Types: Described from male holotype, allotype and one male and two female paratypes, all apterous, bearing the label "Ceylon, Hinidoma 27 Jan. 1958. K. L. A. Perera." Two male and three female paratypes bearing the label "Ceylon, Hinidoma, S. P. 26 Jan. 1958 K. L. A. Perera." One male paratype with the label "Ceylon Hinidoma Ela. 29 Jan. 1958. One female paratype with the label "Ceylon, Opanayeka 13 Sept. 1958 K. L. A. Perera." All the above paratypes are apterous. All the types are in the Francis Huntington Snow Collection at the University of Kansas.

Distribution: Known only from the type localities.

Tenagogonus (Tenagogonus) maai, n sp.
(Figs. A–E)

Size: Apterous male 5.48 mm. long; width across eyes 1.09 mm.; width of pronotum 0.924 mm.; width of body across mesoacetabula 1.64 mm. Macropterous male 5.88 mm. long including wings; width of head across eyes 1.09 mm.; width across humeri 1.26 mm.; width of body across mesoacetabula 1.64 mm. Apterous female 6.72 mm. long; width of head across eyes 1.13 mm.; width of pronotum 1.00 mm.; width of body across mesoacetabula 2.52 mm.

Color: General color pattern stramineous. Even the usual brown to black markings of the pattern characteristic of this genus are no more than pale reddish brown and inconspicuous.

Structural characteristics: Relative lengths of antennal segments: Male 1st:2nd:3rd:4th:::68:64:86:100. Female 1st:2nd:3rd:4th:: 64:53:71:90.

The relative lengths of leg segments in mm.

	Femur	Tibia	1st tarsal segment	2nd tarsal segment
Front leg				
Male	2.14	1.78	0.19	0.30
Female	2.45	2.14	0.24	0.43
Middle leg				
Male	4.59	3.64	1.54	0.48
Female	5.52	4.41	1.67	0.48
Hind leg				
Male	4.33	1.90	0.45	0.36
Female	5.19	2.52	0.57	0.42

Male as seen from above without connexival spines, its seventh abdominal sternite without protuberances. Venter of first genital segment with a broad median longitudinal depression and its rear margin bilobate as shown in Fig. D. Male genital capsule or pygofer without lateral tufts of hairs. Parameres minute and cone-shaped.

Female as seen from above shows the connexival spines short (Figs. B and E). Seventh abdominal tergite more than twice as long as eighth tergite.

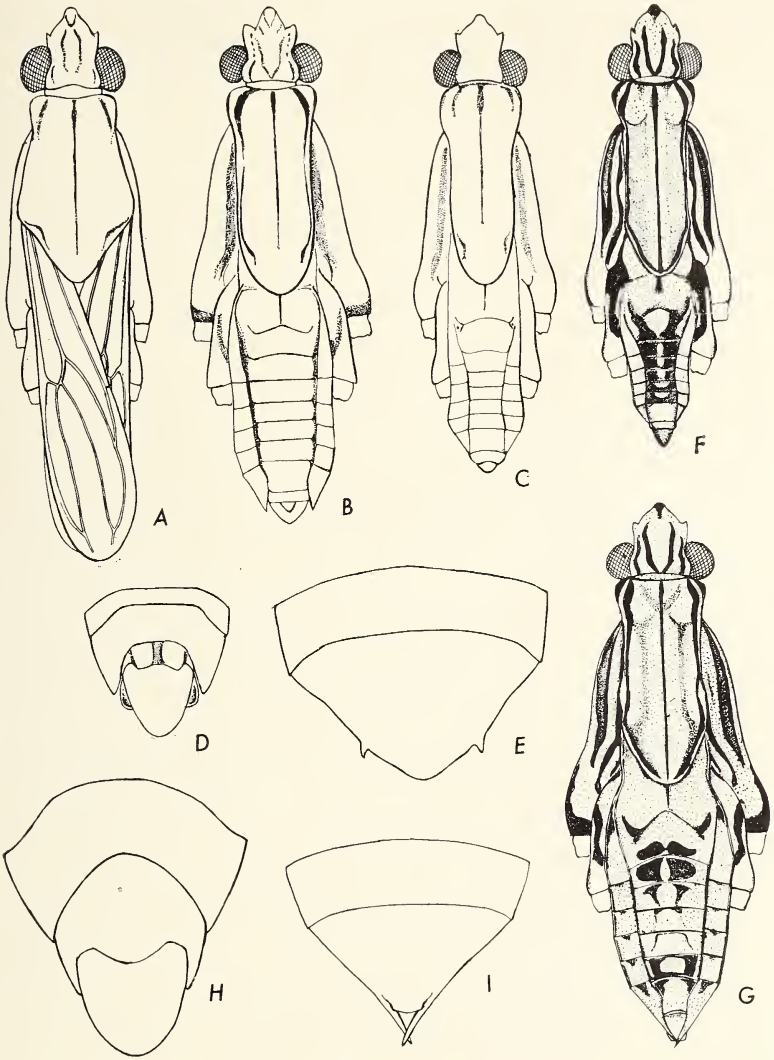
Comparative notes: This species runs out in our key of 1958 to *T. pravipes bergrothi* Hungerford and Matsuda because the pygofer does not have lateral hair tufts. However, it is not that species because the venter of the first genital segment of the male has a broad deep median longitudinal depression, the sides of which are parallel and not shaped as in *Tenagogonus* (*Tenagogonus*) *robustus* Hungerford and Matsuda; nor has it a depressed slender line as in *Tenagogonus* (*Tenagogonus*) *pravipes bergrothi* Hungerford and Matsuda.

Types: In the collection of the Gerridae sent us for determination from the Bernice P. Bishop Museum there were two pinned specimens of this species, one apterous female bearing the labels "British N. Borneo, W. Coast Residency Ranau, 500 m. IX 28 – X 7 1958" and "T. C. Maa collector-Bishop." Beneath these labels was pinned a capsule containing one macropterous male, three apterous males, three apterous females and a nymph. These we have pinned and labelled. The other pinned apterous female bears the printed label "Borneo (Brit. N.) Sandakan 50 m. X 25, 1957." We have chosen the holotype, allotype from the apterous series above and labelled the macropterous male a morphotype. The others are labelled paratypes. All are in the Bernice P. Bishop Museum in Honolulu, Hawaii, except for two paratypes which are in the Francis Huntington Snow Museum at the University of Kansas.

Distribution: Known only from the type localities in the British North Borneo.

Tenagogonus (Tenagogonus) bergrothi, new status

While we have never been able to locate the types of *Tenagogonus pravipes* and have seen no specimens from Java that fit Bergroth's 1915 description (Zool. Med. Rijks Mus. Nat. Hist., Leiden, Deel 1, 1: 121–122) we believe that he was such a careful worker that he would not have overlooked the striking longitudinal depression on the sternum of the first genital segment of the male (Fig. 1). Therefore, our *Tenagogonus pravipes bergrothi* from the Philippines is here referred to full species status, *Tenagogonus* (*Tenagogonus*) *bergrothi* Hungerford and Matsuda.



Figs. A–E, *Tenagogonus* (*Tenagogonus*) *maai* Hungerford and Matsuda. A, Macropterous male. B, Apterous female. C, Apterous male. D, Ventral view of male apical abdominal segments. E, Ventral view of female apical abdominal segments.

Figs. F–I, *Tenagogonus* (*Tenagogonus*) *ceylonensis* Hungerford and Matsuda. F, Apterous male, G, Apterous female. H, Ventral view of male apical abdominal segments. I, Ventral view of female apical abdominal segments.

TWO NEW NASAL MITES, *PTILONYSSUS MOROFSKYI*, N. SP., AND *STERNOSTOMA PORTERI* N. SP., FROM NORTH AMERICAN BIRDS (ACARINA; RHINONYSSIDAE).[1, 2, 3]

By Kerwin E. Hyland[4]

In the course of studying the distribution of the nasal mite fauna in North American birds we have found two additional new species, one belonging to the genus *Ptilonyssus, sensu latu,* collected from a variety of fringillid hosts, the other of the genus *Sternostoma* taken from picid hosts.

Ptilonyssus morofskyi, n. sp.

The fringillids found infested with this species include the American goldfinch, savannah sparrow, song sparrow, vesper sparrow, field sparrow, fox sparrow, and slate-colored junco. *Ptilonyssus morofskyi* is most closely related to *Ptilonyssus serini* Fain, 1956, a species described from several Central African fringillids. It can be separated from *P. serini* on the basis of (1) a larger sternal plate, which is wider than long, (2) an opisthosomal plate which tapers more abruptly posteriorly and possesses on the anterolateral angles a group of alveoli, (3) the anal plate which tapers less abruptly and has a short, wide cribrum and (4) the lack of metasternal setae which are present in *P. serini.*

Female.—*Measurements,* in microns, of holotype and range in parentheses of measured paratypes as follows: LId = 528 (432–528); WId = 322 (290–322); LPP = 180 (175–192); WPP = 175 (169–182); LOP = 161 (149–168); WOP = 120 (116–125); LSP = 96 (84–96); WSP = 110 (103–114); LGP = 106 (105–110); WGP = 67 (65–70); LAP = 48 (48–55); WAP = 55 (48–55); LG = 86 (81–91); WG = 58 (50–60); LP = 50 (46–50); LCH = 62 (58–67); LCh = 4 (4); LPer = 31 (31–34); LLeg I = 254 (243–262); WLeg I = 46 (43–46); LLeg IV = 240 (231–252); WLeg IV = 36 (34–38). (See Fain and Hyland, 1962, for explanation of abbreviations.)

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[1] Supported in part by a research grant (G-11035) from the National Science Foundation. [2] This work was conducted in part while a Fulbright Research Scholar at the Institut de Médecine Tropicale Prince Léopold, Antwerp, Belgium. [3] Contribution number 109 from the Kellogg Gull Lake Biological Station, Hickory Corners, Michigan. [4] Department of Zoology, University of Rhode Island, Kingston, Rhode Island.

Dorsum: (Fig. 8). *Podosomal plate* conspicuously 7-sided with pronounced anteromedian projection; surface with a fine reticulate pattern except in central portion and a pattern of vacuoles as figured; eight pairs of small setae, three pairs of which are larger and more attenuate than the others. *Opisthosomal plate* elongate, about one and one-half times as long as wide and tapering to a blunt point posteriorly; surface with a fine reticulate pattern and a series of vacuoles as figured; seven pairs of setae, the posterior pair stouter and more heavily sclerotized.

Dorsal cuticule striated, with seven pairs of small setae, three pairs lateral and posterior to the podosomal plate and four pairs lateral to the opisthosomal plate. *Stigmata* dorsal, at level of coxa III, with short peritreme.

Venter: (Fig. 3). *Sternal plate* irregularly shaped, wider than long, with a reticulate pattern, three pairs of minute setae and two pairs of pores. *Genital plate* tongue-shaped, with central sclerotized pattern, and with setal bases of genital setae located on the plate and conspicuous (left genital seta only on holotype); genital apodemes conspicuous. *Anal plate* elongate, with a small cribrum (in nearly all specimens cribrum is terminal and directed dorsad; LAP of holotype greater than 48 microns). Paired anal setae attenuate and at level of anal opening; median seta small and blunt. Metasternal setae absent or only a remnant in the form of a setal base at level of coxa IV; opisthosomal cuticule striated and armed with three pairs of small pointed setae in two transverse rows of two and four each.

Gnathosoma: (Fig. 2). Ventral in position; base with one pair of setae and a median row of four or five deutosternal setae ventrally, and dorsolaterally with a row of acuminate denticles. Hypostome ventrally with two pairs of small setae. *Chelicerae* elongate, and with gradual taper. Chela small, movable portion triangular. *Palps* with four free segments, the femur with one ventromedial seta, two dorsal, and one lateral seta; tibia with one ventromedial and three dorsal setae; tarsus with three attenuate and four microsetae ventrally, two attenuate apical setae, and about seven microsetae dorsally.

Legs: All legs six-segmented. Coxae I through III with two microsetae; coxa IV with one seta. Other segments of all legs with one or more short blunt setae per segment ventrally and dorsally with one or more short pointed setae per segment as figured. All tarsi with caruncle and claws. *Tarsus I* (Fig. 1): Sensory plaque with three solenidion-type setae with one longer than others, three long attenuate, and two smaller setae; remainder of dorsal surface fitted with two small attenuate setae; ventrally with six attenuate setae of varying lengths on apical half and two blunt microsetae. Claws straight, tapering and ending within the caruncle. *Tarsus IV* (Fig. 5): Dorsal surface with three short attenuate setae. Ventral surface with two large partially inflated setae and four long attenuate setae located apically, two small microsetae centrally placed and three larger spur-like setae along dorsolateral surface; claws hooked.

Male.—*Measurements:* LId = 317; WId = 187; LPP = 156; WPP = 147; LOP = 134; WOP = 118; Length sterno-genital plate (LSGP) = 161; Width sterno-genital plate (WSGP) = 87; Length ventro-anal plate (LVAP) = 113; Width ventro-anal plate (WVAP) = 82; LAP = 48; WAP = 41; LG = 103; WG = 48; LP = 46; LCH = 50; LCh = 19; LPer = 26; LLeg I = 194; WLeg I = 50; LLeg IV = 178; WLeg IV = 41.

The only male specimen found in the collection which includes 62 females is considerably smaller in all dimensions than the females. To what extent this size differential is representative of the males is not known.

Dorsum: Similar to female. Edges of podosomal plate slightly curled reducing LPP and WPP measurements. Opisthosomal plate wide, with three additional pairs of setae on lateral borders. Cuticle of opisthosoma armed with one pair of small setae.

Venter: Sternogenital plate (Fig. 6) well defined, with irregular borders and partially surrounding the genital opening; central vacuolate pattern distinct. Three pairs of sternal setae on plate, the third pair larger; pores associated with first two pairs; metasternal and genital setae also located on plate. A moderately well defined *ventro-anal plate* (Fig. 7) present bearing two pairs of median setae; anal portion of plate similar to female including setae and cribrum.

Gnathosoma: Palps similar to female; chelicerae with chela forming about two-fifths total length (Fig. 9).

Legs: Legs, including tarsi, similar to female with exception of claws on tarsus I which are hooked.

Protonymph.—Specimen from the field sparrow, *Spizella pusilla*, (Host #A600413–3) with an idiosoma measuring 406 microns in length and 288 in width. Pygidial setae heavy, attenuate, and minutely barbed.

Types.—The *Holotype* and two *paratype* females were collected from the nasal passages of the American goldfinch, *Spinus tristus*, C60–08–18–5, collected at the Kellogg Gull Lake Biological Station, Hickory Corners, Kalamazoo Co., Michigan, by David T. Clark on 18 August 1960. The *allotype* male, the only male seen, was taken from the savannah sparrow, *Passerculus sandwichensis,* H61–09–23–12, in New Shoreham (Block Island), R. I., by G. West, K. Hyland and L. TerBush on 23 September 1961 along with 3 *paratype* females.

Other paratypes and the hosts on which they were collected are as follows: On *Passerculus sandwichensis,* (savannah sparrow); 3 ♀♀, Block Island, R. I., G. West, K. Hyland and L. TerBush, H61–09–23–12; 1 ♀, Block Island, R. I., G. West, K. Hyland and L. TerBush, H61–09–23–14; 6 ♀♀, Block Island, R. I., G. West, K. Hyland and L. TerBush, H61–09–23–27. On *Pooecetes gramineus* (vesper sparrow): 1 ♀, Gilkey Lake, Barry Co., Michigan, K. Hyland, Hedwig Ford and D. T. Clark, 59–07–08–14. On *Junco hyemalis* (slate-colored junco): 1 ♀, Block Island, R. I., G. West, K. Hyland and L. TerBush, H61–09–23–7. On *Spizella pusilla* (field sparrow): 11 ♀♀, 5 NN, Weeping Water, Nebraska, N. Braasch, A600413–3. On *Passerella iliaca* (fox sparrow): 11 ♀♀, Kingston, R. I., G. West, H61–11–27–2. On *Melospiza melodia* (song sparrow): 15 ♀♀, Raynham, Mass., R. Hayes, H60–08–04–2; 2 ♀♀, Duck Lake, Hickory Corners, Mich., D. T. Clark, C60–07–28–3; 2 ♀♀, 42nd St. N., Kalamazoo Co., Mich., D. T. Clark, C60–07–27–9; 8 ♀♀, 1N, South Kingstown, R. I., L. TerBush, H61–05–05–8.

The holotype has been deposited in the United States National Museum (USNM No. 2690), as has the allotype, two paratypes and a protonymph. Paratypes have been deposited with the Entomological Museum, Michigan State University, with Alex Fain, Institut de Médecine Tropicale Prince Léopold, Antwerp, Belgium, with R. W. Strandtmann, Texas Technological College, Lubbock, and in the collection of the author.

Ptilonyssus morofskyi is named for Walter F. Morofsky, Director of the Kellogg Gull Lake Biological Station, a branch of Michigan State University where this work was initiated.

Sternostoma porteri, n. sp.

This species has been collected from the nasal cavities of the yellow-shafted flicker (*Colaptes auratus*) and the downy woodpecker (*Dendrocopos pubescens*) and is the first rhinonyssid reported from the family Picidae.

This species appears most closely related to *Sternostoma dureni*

Fain, 1956, but differs from it in having a longer and narrower sternal shield, a more elongate podosomal plate, and an anal plate which is more elongate and in which the setae are all situated well behind the anal opening. The dorsal plates of *Sternostoma hutsoni* Furman, 1957 and *S. porteri* are similar but the sternal plate of *S. hutsoni* is keg-shaped and not nearly as long as for *S. porteri,* and the genital plate is smaller in both dimensions than in *S. hutsoni.* *S. porteri* can be separated from all known species of *Sternostoma* with the exception of *S. nectarinia* Fain, 1956, on the basis of a sternal plate which is two and one-half times as long as wide. It can be separated from *S. nectarinia* by differences in the shape of the podosomal, opisthosomal, genital and anal plates.

Female.—*Measurements* of holotype and range in parentheses of measured paratypes as follows: LId = 806 (470–806); WId = 325 (269–358); LPP = 325 (283–325); WPP = 216 (208–224); LOP = 177 (156–203); WOP = 138 (138–153); LPer = 11.7 (11.7–13.0); LSP = 158 (120–158); WSP = 55 (44–68); LGP = 106 (91–109); WGP = 53 (53–65); LAP = 62 (52–78); WAP = 56 (34–56); LG = 182 (106–182); WG = 83 (83–104); LP = 94 (57–94); LCH = 112 (96–117); LCh = 6.8 (5.7–6.8); LLeg I = 380 (286–380); WLeg I = 91 (65–96); LLeg IV = 381 (291–381); WLeg IV = 78 (55–81).

Dorsum: Podosomal plate longer than wide, somewhat pentagonal, with broad anteromedian projection, concave lateral borders, and convex posterior border. Surface with a pattern of alveoli as figured, a background of lines forming a mosaic pattern and with punctations; armed with seven pairs of minute setae, three pairs located along lateral border and four pairs medially; with two pairs of pores. *Opisthosomal plate* longer than wide, wider anteriorly and tapering to blunt point posteriorly. Surface with a pattern of alveoli as figured, a background of lines forming a network, and punctations; four pairs of minute setae located medially. Dorsal surface of opisthosoma finely striated and with three pairs of microsetae. *Stigmata* dorsal, at level of coxa III, small, without peritreme.

Venter: Sternal plate elongate, approximately two and one-half times as long as wide, with faint borders, and a finely punctate surface; three pairs of setal bases are evident but setae are wanting. *Genital plate* small, elongate, finely punctate and with a median quadripartite vacuolate area. Genital apodemes conspicuous. *Anal plate* terminal, elongate with small cribrum; three setae all positioned posterior to anal opening. Cuticle finely striated, three pairs of minute setae located on opisthosomal integument.

Gnathosoma: Ventral in position, base without setae and without dorsal ctenidium. *Chelicerae* elongate, with moderately abrupt taper toward tip; chelae small, movable digit triangular in shape. *Palps* with four free segments, femur without setae, genu with two dorsal and two lateral setae, tibia with three dorsal and two lateral setae, tarsus with two moderately long terminal setae and three or four subterminal microsetae dorsally and two subterminal microsetae ventrally.

Legs: All legs six-segmented. Most segments with several small pointed setae on both dorsal and ventral aspects. Tarsi with modified setae, caruncles and claws. *Tarsus I* (Fig. 13): Sensory plaque with three solenidia, three attenuate, and two microsetae. Remaining dorsal surface with five short pointed setae, and ventrally with five similar setae. Claws slightly curved, pointed and ending within carnucle. *Tarsus IV* (Figs. 13, 14): Dorsally with basal row of three small pointed setae, and distad another row of three, the middle seta more attenuate. Distally with two long attenuate setae. Ventral surface with three pointed setae positioned as illustrated (Fig. 13), and three expanded setae located distally. Claws well developed, hooked.

Male.—Unknown.

Nymph.—The single nymph was taken from *Colaptes auratus* (H62–06–26–4) and measures 538 microns in length and 288 in width. All plates on idiosoma are lacking with exception of a poorly demarcated anal plate. Claws on tarsus I small, short (10 microns) and slightly hooked.

Types.—*Holotype* and one *paratype* female were collected from the yellow-shafted flicker, *Colaptes auratus,* taken at the Kellogg Bird Sanctuary, Hickory Corners, Kalamazoo County, Michigan by T. W. Porter, 17 Aug. 1958.

Other paratypes and the hosts on which they were collected are as follows: On *Colaptes auratus* (yellow-shafted flicker): 7 ♀♀, Bradford, R. I., A. Moorhouse, H62–09–08–1; 4 ♀♀, IN, Kingston, R. I., A. Moorhouse, H62–06–26–4; 1 ♀, Kingston, R. I., A. Moorhouse, H62–06–25–1; 1 ♀, Kalamazoo Co., Mich., K. Hyland, Hedwig Ford & D. T. Clark, 59–07–10–1. On *Dendrocopos pubescens* (downy woodpecker): 2 ♀♀, Shiawesee Co., Mich., D. T. Clark & Hedwig Ford, C60–09–03–5; 1 ♀, Gothenburg, Nebr., N. Braasch & W. Atyeo, A590610–9; 2 ♀♀, Kalamazoo Co., Mich., D. T. Clark and Mary English, C60–08–04–1; 9 ♀♀, Kalamazoo Co., Mich., Hedwig Ford and D. T. Clark, 59–08–02–2.

The holotype has been deposited in the United States National Museum (USNM No. 2691) along with two paratypes and the nymph. Paratypes have also been deposited with the Entomological Museum, Michigan State University, the Entomological Museum, University of Nebraska, in the collections of Alex Fain, Institut de Médecine Tropicale Prince Léopold, Antwerp, Belgium, R. W. Strandtmann, Texas Technological College, Lubbock, and the author.

Sternostoma porteri is named for T. Wayne Porter, Assistant Director of the Kellogg Biological Station, Hickory Corners, Michigan.

ACKNOWLEDGMENTS

The author wishes to thank Dr. Alex Fain, Institut de Médecine Tropicale Prince Léopold, Antwerp, Belgium, for the use of his facilities in carrying out a portion of this work, and for his kind advice and criticisms.

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EXPLANATION OF PLATES

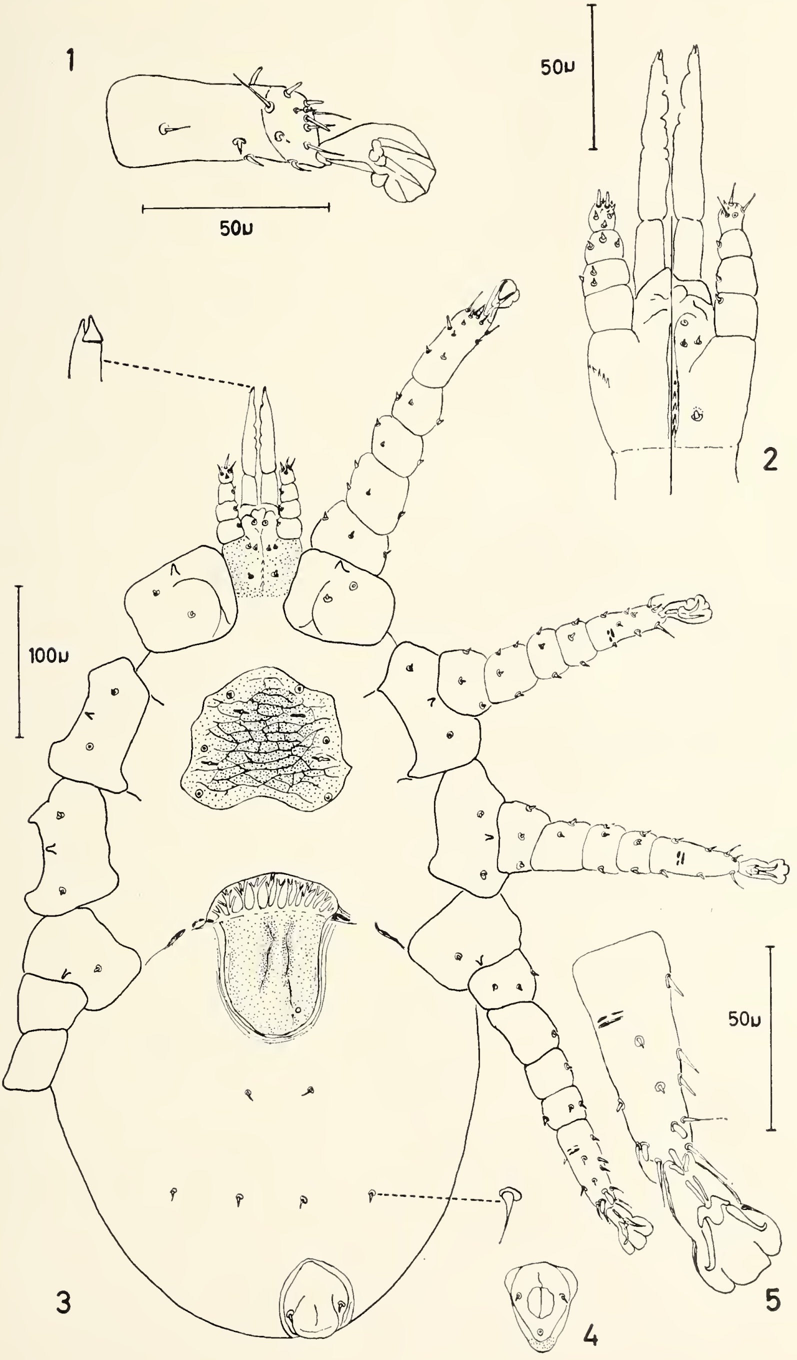
Ptilonyssus morofskyi, new species. Fig. 1, Tarsus I, dorsolateral view. Fig. 2, Gnathosoma: right, ventral view—left, dorsal view. Fig. 3, Ventral view. Fig. 4, Anal plate of paratype from *Spizella pusilla.* Fig. 5, Tarsus IV, ventral view. (Figs. 1, 2, 3, and 5 of holotype).

Ptilonyssus morofskyi, new species. Fig. 6, Sternogenital plate and Fig. 7, Ventro-anal plate of allotype male from *Passerculus sandwichensis.* Fig. 8, Dorsal view, holotype. Fig. 9, Chelicera of allotype.

Sternostoma porteri, new species. Fig. 10, Podosomal plate of paratype female from *Dendrocopos pubescens.* Fig. 11, Gnathosoma of holotype: right, ventral view—left, dorsal view. Fig. 12, Dorsal view, holotype.

Sternostoma porteri, new species. Fig. 13, Tarsus IV, ventral view; Fig. 14—Tarsus IV, dorsal view. Fig. 15, Tarsus I, dorsal view; Fig. 16, Ventral view, holotype. Fig. 17, Anal plate of paratype from *Dendrocopos pubescens.*

HYLAND PLATE I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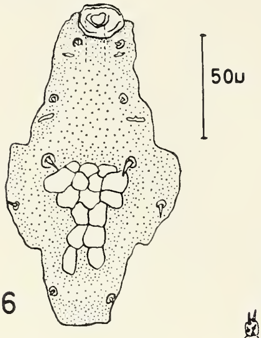

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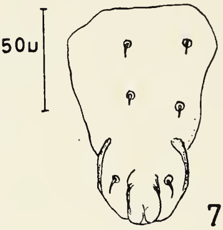

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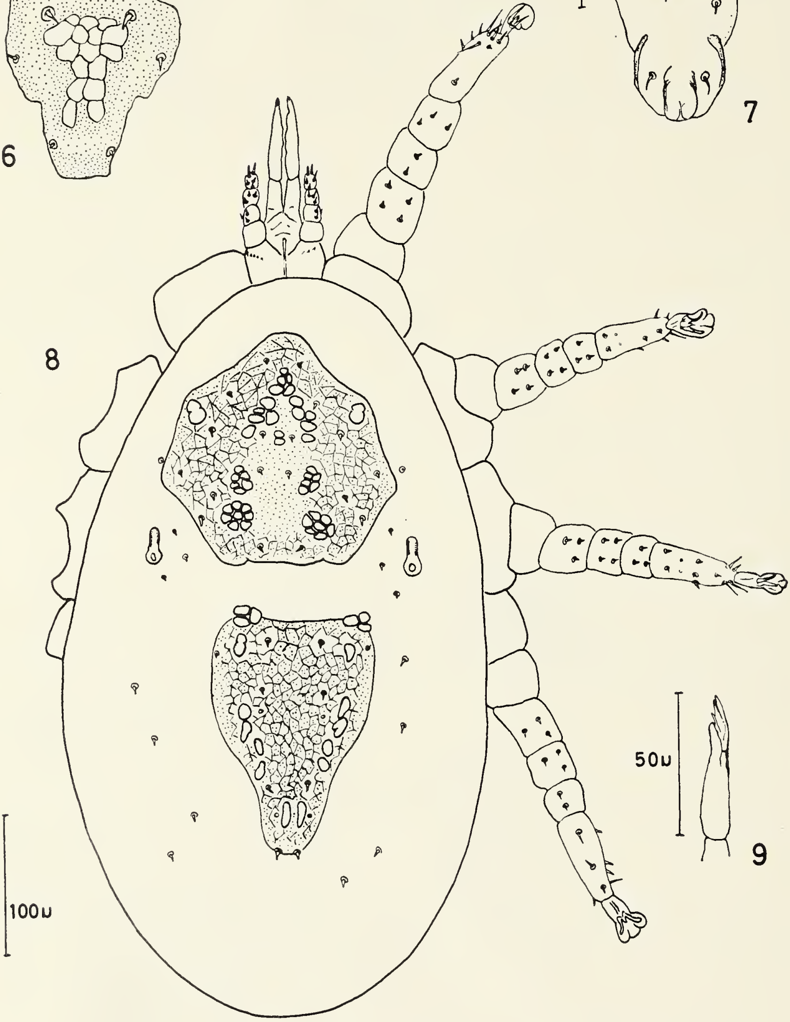

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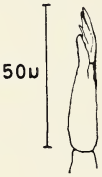

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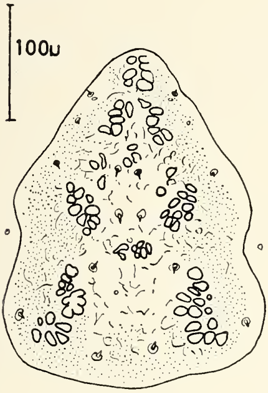

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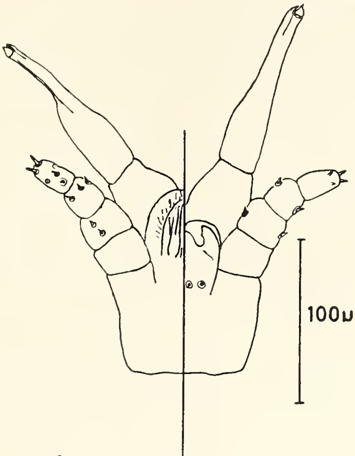

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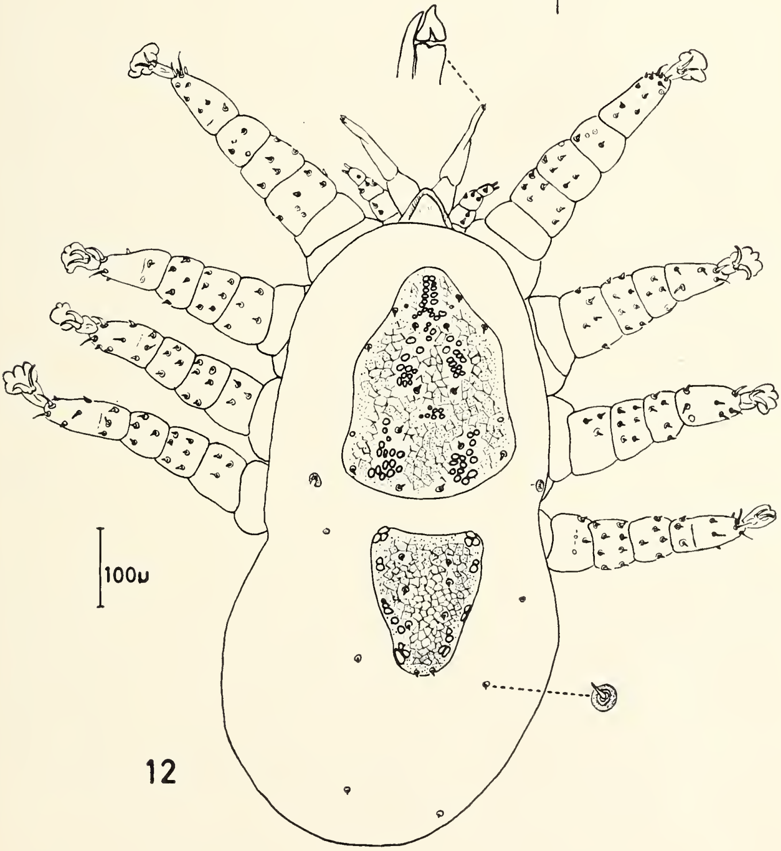

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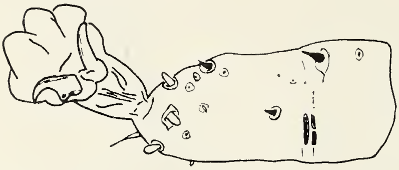
HYLAND PLATE IV



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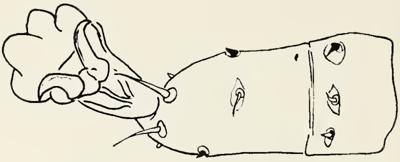

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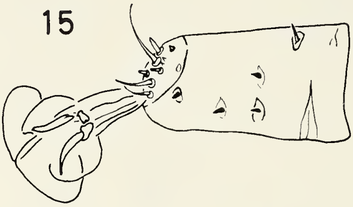

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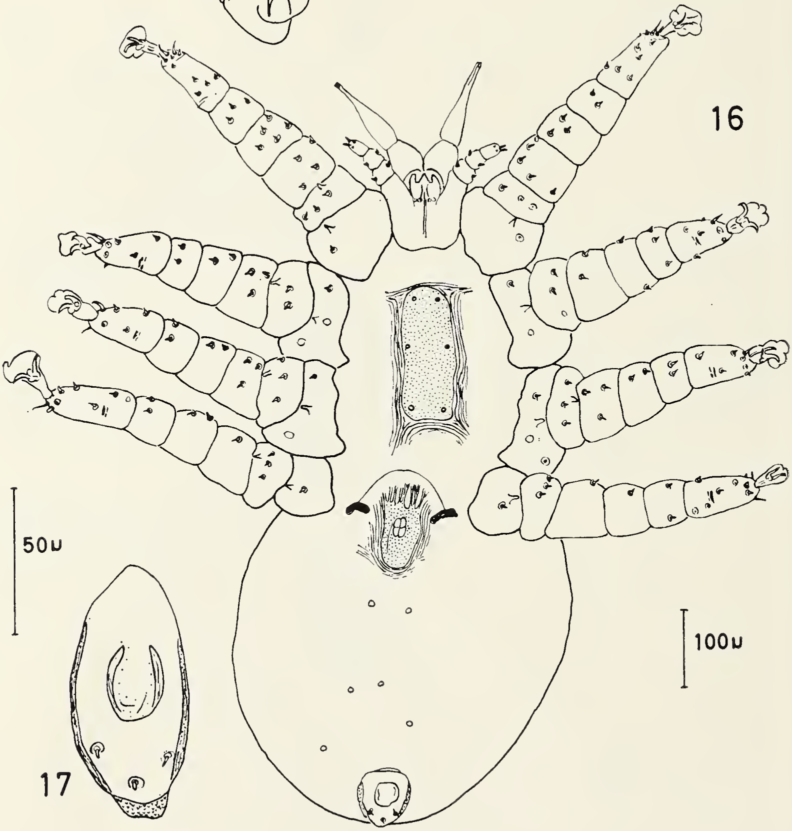

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ASIAN BITING FLY STUDIES I[1]: TABANIDAE—SPECIES RELATED TO *TABANUS BASALIS* MACQUART, 1838, WITH THE DESCRIPTION OF A NEW SPECIES FROM NEPAL

By Edward I. Coher[2]

Oriental species of Tabanidae are in great need of revision using modern taxonomic methods. Unfortunately most collections of Asian tabanids are fragmentary and practically nothing is known of the biology of the species. With the quantity of material available to me[1], a preliminary grouping and revision is now advisable. Some errors in synonymy and interpretation of species relationships will almost certainly result because of lack of access to many of the pertinent types and the poor quality of old descriptions.

Descriptive studies of the Tabanidae are complicated by our poor understanding of variation at the species level and a lack of structural characters in these flies. As a result there is much dependency on tinctorial characters. These problems have been discussed by Stone (1938: 2,4). Unfortunately the color and pattern of a poorly preserved or a preserved and subsequently mounted tabanid may have practically no relation to that of a well preserved or freshly captured one. This factor is the most difficult one with which the taxonomist must contend.

Species in the *basalis* group are: 1, *abbasalis* Philip, 1960, Thailand; 2, *annamensis* Philip, 1960, Annam; 3, *basalis* Macquart, 1838, Sumatra, Java; 4, *chrysater* Schuurmans Stekhoven, 1926, Java; 5, *cinnamomeus* Doleschall, 1858, Amboina; 6, *fuscomaculatus* Ricardo, 1911, Upper Burma, Sikkim; subsp. *altermaculatus* Ricardo, 1913a, Manipur; var. *unisignatus* Szilady, 1926, So. Celebes; 7, *jacobi*, n.sp., Nepal; 8, *joidus* (Bigot), 1892, Assam; 9, *laotianus* (Bigot), 1892, Laos; 10, *ochroater* Schuurmans Stekhoven, 1926, Sumatra; 11, *pallidepectoratus* (Bigot), 1892, Cochin

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[1] Under the title 'Asian Biting Fly Studies', the examination of various groups of potential and known vector species of flies is being supported by a grant from the National Institutes of Health (E-4541) and is administered by the Smithsonian Institution. The principal groups to be studied are the Culicidae and the Tabanidae. Collections of the mosquitoes are available from Nepal, Thailand, Afghanistan, New Guinea and the Philippines; of tabanids from Nepal and Thailand.

[2] 599 Main St., Waltham 54, Mass.

China, Formosa; var. *aurea* Surcouf, 1922, Laos; 12, *pendleburyi* Philip, 1960, Brit. No. Borneo; 13, *pseudopallidepectoratus* Surcouf, 1922, Laos; 14, *siamensis* Ricardo, 1911, Thailand; 15, *sziladyi* Schuurmans Stekhoven, 1932, ? Sumatra, ? China; 16, *thurmani* Philip, 1960, Thailand; 17, *xanti* Szilady, 1926, So. Celebes.

Although it would be desirable to have a key to the species which are included in the *basalis* group, the descriptions of most of the species are so poor that it is not possible with my present knowledge of the group to construct an accurate key. However, I have grouped the species according to the number of basal abdominal tergites which are wholly or almost wholly deep yellow or orange:

Species with only the first two abdominal tergites so colored: *abbasalis, basalis, ochroater.*

Only first three abdominal tergites so colored: *jacobi, pendleburyi, ?sziladyi, thurmani.*

Only first abdominal tergites so colored: *annamensis, chrysater, fuscomaculatus, f.* ssp. *altermaculatus, joidus, pseudopallidepectoratus, siamensis, ?xanti.*

First five abdominal tergites so colored: *pallidepectoratus, p.* var. *aurea.*

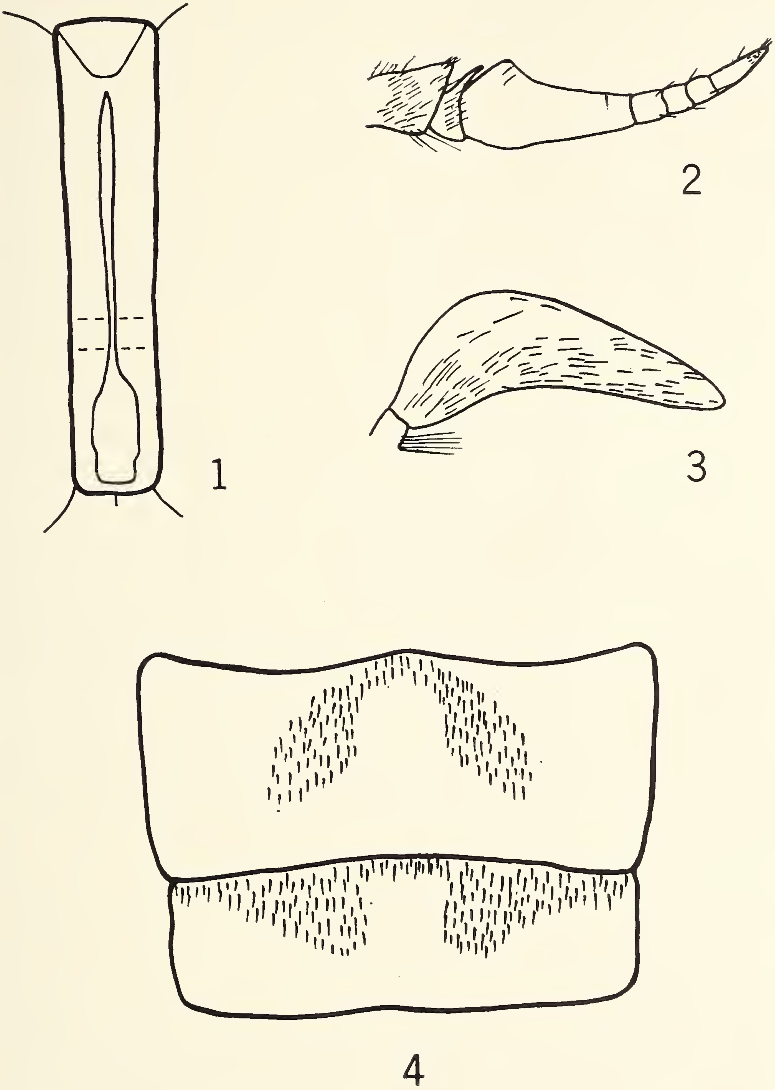
Species whose names are preceded by question marks are not clearly described, and there is no information available on the following: *cinnamomeus, laotianus, fuscomaculatus* var.

Collections listed in this paper were made by myself except where otherwise stated.

1. **Tabanus jacobi**, n. sp.

Female.—Head: with subcallus, face, and cheeks yellow; frons golden pollinose and nearly parallel-sided, with index of 6; callosity (Fig. 1) red-brown, subrectangular, tapered and confluent with narrow median, line-like red-brown callus (sometimes divided by pollinosity in area delimited by dotted lines on figure) and not touching eye margin; vertexal triangle variable, sometimes reaching median callosity, sometimes almost absent; antenna (Fig. 2) with scape, pedicel, and plate orange, with style extremely variable but at least apex of last segment dark red-brown; parafacials and face, particularly dorsolateral corner, with fine yellow setae; beard yellow; palpus (Fig. 3) yellow, with variable mixture of black and yellow setae. *Thorax:* olive-green tomentose, somewhat more gray just dorsal to coxae, with pilosity mainly yellow and with some dark setae intermixed on scutum and a small patch of black setae anterior to mesocoxae. *Legs:* with coxae olive-green or grayish

COHER



Tabanus jacobi, n. sp. Fig. 1, Frons. Fig. 2, Antenna. Fig. 3, Palpus. Fig. 4, Tergal segments II and III showing setal pattern.

tomentose with yellow and black setae; remainder purple-brown with concolorous setae except for basal half of foretibia and slightly more than basal half of mid and hind tibiae and some setae at base of mid and hind femora, all of which are orange-yellow. *Abdomen:* with tergites I to III orange with golden setae; TII (Fig. 4) with a median inverted broadly v-shaped patch of black setae; TIII (Fig. 4) with a variable median patch of black setae also resembling an inverted 'v' having a lateral extension along the basal margin of the segment; TIV to TVII with black setae, the integument with a hint of a lighter median apical triangle; SII to III orange, with a variable mixture of orange and black setae; SIV to VII black, with black setae. *Haltere:* orange. *Wing:* yellowish near base and along costal margin, suffused along R_3 and smoky through cells R_3, R_4, R_5, M_1, M_2, M_3 and apically in Cu.

Types.—Holotype female: **Nepal**, Amlekhganj, 350 m., 30 July 1956, Shannon trap; in USNM collection. *Paratopotypes:* 30 July 1956, 5 ♀♀, Shannon trap; 8 July 1956, 2 ♀♀, Shannon trap; 10 July 1956, 7 ♀♀, (L. B. Jha), 2 ♀♀ (Keshav Ram), Shannon trap; 19 July 1956, 1 ♀, biting man; 8 Aug. 1957, 1 ♀, Shannon trap; 28 Aug. 1957, 19 ♀♀, Shannon trap; 29 Aug. 1957, 1 ♀, Shannon trap; 29 Aug. 1957, 1 ♀, at light. *Paratype:* Nepal, Baridamar, 7 Oct. 1957, 1 ♀, Shannon trap.

Discussion.—I take great pleasure in naming this species for Dr. V. P. Jacob in whose company I spent two extraordinary years in the Nepal terai. This species is most closely related to *fuscomaculatus* but differs by having only the first three abdominal tergites orange and by the form of the setal pattern. The setal pattern of the third segment is larger than that of the second in *jacobi,* whereas that on the third segment is smaller than that of the second in *fuscomaculatus.*

2. *Tabanus thurmani* Philip, 1960.

Philip, 1960, St. Inst. Med. Res. Fed. Malaya No. 29: 24, illus.

My material consists of a single topotypic female taken at a light. Comparison with the type indicates that some emendation of the original description is necessary. Both specimens show a median integumental orange area extending along the apical margin of TV and an integumental orange margin to TVI. My specimen which is in fresher condition than the type shows: subcallus, parafacials, and face yellow-brown pollinose, the median ventral portion of the face suffused red-brown; frons golden pollinose; beard yellowish posteriorly; integument of basal two-thirds of foretibia orange-brown; SV with olive-green pollinosity apically.

Material examined.—**Thailand,** Chiengmai, 13 July 1959.

3. *Tabanus siamensis* Ricardo, 1911.

Ricardo, 1911, Rec. Indian Mus. 4: 212, illus.

I have assigned a single female specimen to this species despite small differences from the description of *siamensis* which was originally described from badly rubbed material. The principal distinctive features of my specimen are: subcallus, face, vertex and mesonotum golden tomentose; frontal callus almost triangular rather than subquadrate with a dorsal linear extension; no yellow setae or integumental color on the posterior margin of sternites V and VI.

Material examined.—**Laos,** 40 miles E. of Vientiane on road to Pak San, 21 June 1959 (P. F. Beales).

4. *Tabanus pallidepectoratus* (Bigot), 1892.

Bigot, 1892, *Atylotus,* Mem. Soc. Zool. France 5: 57.
Ricardo, 1913, Ann. Hist.-Nat. Mus. Natl. Hung. 11: 172, ♂.

The male of this species was described from Formosa by Ricardo (1913b). I have seen a single additional male specimen in the collection of the Museum of Comparative Zoology at Harvard University.

Material examined.—**Formosa,** Hori, 6 June 1934 (L. Gressitt).

ACKNOWLEDGMENTS

I would like to thank Mr. Peter F. Beales for the specimen of *siamensis,* the Museum of Comparative Zoology, Harvard University and the U.S. National Museum for allowing me to study pertinent material, and Dr. John F. Hanson for his critical reading of the manuscript. To my numerous assistants in the field without whose help the placement of traps would have been extremely difficult I wish to express my gratitude for their part in the development of this and all future studies in this series of papers.

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ANNOUNCEMENT

A List of the Aphids of New York, by Mortimer D. Leonard, Washington, D. C. Proceedings of the Rochester Academy of Sciences, Vol. 10, No. 6, pp. 289–428, 4 plates. 1963. The life histories, economic importance, method of feeding, production of winged forms, productivity, role as vectors of plant viruses, and other pertinent information are discussed as introductory material. Detailed records of the distribution of about 350 species of aphids known to occur in New York and a list of over 700 food plants on which they occur are given. (For sale at $1.50 by the Librarian, Rochester Academy of Science, Rush Rhees Library, University of Rochester, Rochester, N. Y.)

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REVIEW OF THE GENUS *ATRACTOTOMUS* FIEBER IN NORTH AMERICA WITH NOTES, KEY, AND DESCRIPTION OF ONE NEW SPECIES (HEMIPTERA: MIRIDAE)

By Richard C. Froeschner[1]

Among some miscellaneous Hemiptera collected from bitterbrush, *Purshia tridentata* (Pursh) DC., in Idaho by M. M. Furniss and submitted by him for identification were specimens of a species of *Atractotomus* Fieber that appears to be new. It is being described at this time so that the name will be available for reporting the insect's activities on that host.

To aid in recognition of this and other North American species of the genus, a key is included.

Studies to determine the organisms on which members of this genus actually feed are needed. Although several species have been reported as associating with certain plants (*mali* (Meyer) with apple, *magnicornis* (Fallén) with evergreens, and several with their "host's" name incorporated in their own), *mali* has been credited with being "predaceous on green apple aphid" and on small caterpillars. Possibly all the forms are carnivorous rather than herbivorous.

Atractotomus purshiae, n. sp.

Diagnosis: The extremely short second antennal segment (subequal to width of vertex) separates this species from all other forms known from North America except *balli* Knight; however, the black osteolar peritreme described for *balli* affords a ready separation since that structure is conspicuously paler than the surrounding sclerites in *purshiae*.

---

[1] Entomology Research Division, Agric., Res. Serv., U. S. Department of Agriculture, Washington, D. C.

Description (all measurements given in millimeters): General color black with appendages, including tarsi, weakly embrowned; membrane dark gray with basal margin black; osteolar peritreme dirty white. With long, blunt, silvery-white, scalelike pubescence, as follows: dorsally most dense on head and pronotum, becoming less dense posteriorly and smaller and more scattered over most of membrane; ventrally most dense laterally; present also on coxae, femora (especially anterior surfaces), and sparsely so on tibiae. Antennae fuscous throughout, with no pale scales, segments I and II with dense, blackened hairs, III and IV with light and dark hairs mixed. Labium reaching between hind coxae.

Dimensions: Male holotype: length 2.36; width 1.24. Head: width 0.88, vertex 0.48. Antennal segments: I, 0.18; II, 0.48 (diameter 0.12); III, 0.23; IV, 0.20. Pronotum: length 0.40, width 1.08. Female: length 2.53; width 1.29. Head: width 0.88, vertex 0.48. Antennal segments: I, 0.14; II, 0.48 (diameter 0.13); III and IV missing. Pronotum: length 0.45, width 1.05.

Holotype: Male, collected six miles south of Krassel Ranger Station, Valley County, Idaho, 29 May 1961, M. M. Furniss, elevation approximately 4,000 feet, from *Purshia tridentata,* Hopkins number 40971F (United States National Museum Type Number 66078). *Paratypes:* Two ♂♂, same locality and host as *allotype,* collected 29 May and 27 June 1961; six ♀♀, same locality and host as holotype, collected July 13 and 21 1961.

Nymphs and adults were found on the same hosts on all dates given above. The nymphs are red in color. The early instars lack the thickened second antennal segment which is so characteristic of the adults, but with successive molts this modification becomes more evident.

In contrast, during equally intensive work on *Purshia* in Boise County at an elevation 1,000 feet higher than in Valley County, this mirid was not found.

KEY TO THE NORTH AMERICAN SPECIES OF ATRACTOTOMUS

1. Antennal segment II as long as or longer than width of head across both eyes 2
   Antennal segment II shorter than width of head across eyes 6
2. Antennal segment II as long as or longer than basal width of pronotum; tibiae and apical third or more of femora orange red; length, ♂ 7.7, ♀ 5.0–5.2 mm .. hesperius (Uhler)
   Antennal segment II not or little more than three-fourths as long as basal width of pronotum 3

3. Entire dorsum, especially anteriorly, with crowded, broadly
   obovate, silvery-white scale-like pubescence; coxae creamy
   white, contrasting strongly with black pleura; length
   3 mm .... *albidicoxis* Reuter
   Entire dorsum with flattened pale pubescence narrow, long,
   and attenuate apically; coxae black, concolorous with
   pleura 4
4. Labium short, scarcely attaining apices of middle coxae;
   length 2.6–2.8 mm .... *flavotarsus* Johnston
   Labium long, reaching well between hind coxae 5
5. Dorsal surface of front and middle tibiae yellow with a complete,
   longitudinal row of close-set tiny black tubercles;
   length 3.0–3.6 mm .... *mali* (Meyer)
   Dorsal surface of front and middle tibiae yellow or fuscous
   to black but without a row of tubercles; length 3.0–3.4
   mm .... *magnicornis* (Fallén)
6. Hind tibiae yellowish white with a conspicuous fuscous spot
   surrounding insertions of some of the spines; length
   2.3–2.6 mm .... *acaciae* Knight
   Hind tibiae dark fuscous to black 7
7. Osteolar peritreme black, concolorous with pleura 8
   Osteolar peritreme distinctly paler than surrounding pleura 10
8. Antennal segment II as long as or longer than width of
   vertex plus one eye 9
   Antennal segment II shorter, its length subequal to width of
   vertex; length 2.3–2.5 mm. .... *purshiae*, new species
9. Antennal segment I short, its length subequal to diameter of
   antennal II; length 2.7–3.1 mm .... *reuteri* Knight
   Antennal segment I longer, its length more than twice the
   diameter of antennal II; length 3 mm .... *cercocarpi* Knight
10. Antennal segment II almost twice as long as width of vertex
   (60.35); length 2.6–2.8 mm .... *crataegi* Knight
   Length of antennal segment II subequal to or shorter than
   width of vertex; length 2.6 mm .... *balli* Knight

Notes on the North American species of Atractotomus

1. *Atractotomus acaciae* Knight. One pair was collected during May at Douglas, Arizona, just southeast of the type locality at Tucson.

2. *Atractotomus albidicoxis* Reuter. Reuter's type from the Heidemann collection was found in the United States National Museum. It was the Arizona female listed with the original de-

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scription (even to the abbreviation for the Chiricahua Mountains) and bears a label in Reuter's handwriting indicating it to be a "n. sp." On this label the species name is spelled without the syllable "di." The specimen has been assigned U. S. N. M. Type Number 66077.

3. *Atractotomus balli* Knight. So far this species is known only from the type from Arizona.

4. *Atractotomus cercocarpi* Knight. Knight's original records for Arizona and New Mexico still stand as the only distributional data.

5. *Atractotomus crataegi* Knight. Again, the only distributional record, Iowa, is that given by Knight with the original description.

6. *Atractotomus flavotarsus* Johnston. This species is included in the above key solely on the basis of the original description. The separation as stated is weak and specimens are needed for evaluation. Specimens found breeding on bluet, *Houstonia angustifolia* Michx., in Texas during April and May comprised the type series.

7. *Atractotomus hesperius* (Uhler). Originally described as the basis for the genus *Dacota,* this species appears restricted to the mountainous western parts of the United States. In his "Catalogue" Carvalho listed it for California and Wyoming; I have seen specimens from Montana and Arizona; and Uhler reported it from Colorado and "Dakota" (the latter locality undoubtedly referred to the old Dakota Territory rather than to the present Midwestern States of that name).

The great disparity in size of the two sexes results from a sexual dimorphism in wing length. In the male the wings are so greatly elongated that the tip of the abdomen scarcely reaches the base of the cuneus; in the female the wings are much shorter, the tip of the abdomen reaching to the apex of the cuneus.

8. *Atractotomus magnicornis* (Fallén). The presently used concept is based on European specimens, determined by Reuter, in the U. S. National Museum. This evergreen-frequenting species was first reported from North America in 1923 by Knight, who had specimens from evergreens in New York. From this same material he described the variety *buenoi,* which he characterized as being "smaller and more ovate" and having the second antennal segment just as long as width of head across both eyes instead of longer, as in the nominal form.

9. *Atractotomus mali* (Meyer). This is another European species which was first reported from North America by Knight in

1924. He listed specimens from Nova Scotia as being "predaceous on green apple aphid." Since no North American specimens were available for study, European material in the U. S. National Museum was used to construct the above key. The row of close-set, tiny, black tubercles on the dorsal faces of the front and middle tibiae has not been used as a taxonomic character. If examination of more material establishes the constancy of this character (it occurs elsewhere in the Miridae), it should be very useful because it is missing from *albidicoxis, acaciae, hesperius, magnicornis* and *reuteri.*

10. *Atractotomus purshiae* Froeschner. See notes with original description in the present paper.

11. *Atractotomus reuteri* Knight. This species was originally described as *Atractotomus hesperius* by Reuter from a specimen from Siskiyou County, California, in the Heidemann collection. When Knight found it necessary to synonymize Uhler's genus *Dacota* with *Atractotomus* there resulted a conflict with Uhler's earlier use of *hesperius* within the genus. Since Uhler's use has priority of twenty-seven years over that of Reuter's, Reuter's species had to be renamed.

In the collection of the United States National Museum is a series of seven specimens from Siskiyou County, California, of which one female bears Reuter's determination *"Atractotomus hesperius n. sp."* Because Reuter cited only one female and this specimen agrees with the original description, it is assumed that Heidemann sent to Reuter only one member of the series. This specimen is therefore accepted as the type and given the U. S. N. M. Type Number 66076. In addition the collection contains two specimens from Placer County, California, and one from Las Vegas, New Mexico.

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——— 1924. Atractotomus mali (Meyer) found in Nova Scotia (Heteroptera, Miridae). Bul. Brooklyn Ent. Soc. 19: 65.

UNDESCRIBED SPECIES OF NEMATOCEROUS DIPTERA. PART XII.[1]

By Charles P. Alexander, Amherst, Mass.

The preceding part under this general title appeared in April 1962 (Bul. Brooklyn Ent. Soc., 57: 33–39). In the present paper I am describing three new species of Tipulidae belonging to the genus *Ctenacroscelis* Enderlein from Assam, India, collected by Dr. Fernand Schmid, to whom my thanks are extended for invaluable help in making known the rich and varied crane-fly fauna of India. The genus *Ctenacroscelis* contains the World's largest known crane-flies, some with a wing expanse exceeding 100 millimeters. All known species are Old World, with a marked concentration of forms in southern Asia, including more than 30 now known from India.

TIPULIDAE

Ctenacroscelis hansoni, n. sp.

Belongs to the *brobdignagius* group; size very large (wing of male 39 mm.); antennae light brown, pedicel yellow, terminal segment black; head buffy with a conspicuous dark brown central stripe that is narrowed behind; dark pleural stripe narrow; femora brownish yellow, tips brownish black, last tarsal segment pale; wings relatively broad, almost uniformly rich brown; R_1 at fork of R_{2+3}; abdominal tergites dark brown, lateral borders narrowly yellowish gray, sternites light yellow; male hypopygium with tergite shallowly emarginate, without lateral hair pencils; inner dististyle without a basal lobe; eighth sternite with posterior border very deeply emarginate, lobes unusually conspicuous, projecting, provided with abundant but relatively short yellow setae.

Male: Length about 33 mm.; wing 39 mm.; antenna about 5 mm.

Frontal prolongation of head cinnamon brown above, dark brown on sides; nasus elongate; palpi black. Antennae light brown, pedicel yellow, terminal segment black; flagellar segments nearly cylindrical, setae small and sparse. Head above buffy, more yellowed before eyes; a narrow but conspicuous dark brown central stripe on vertex, slightly widened and bifid on the low entire vertical tubercle, narrowed behind, attaining the occiput; genae less evidently darkened.

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[1] Contribution from the Entomological Laboratory, University of Massachusetts.

Cervical sclerites darkened laterally. Pronotum broadly brown above, sides light yellow. Mesonotal praescutum with four dark gray stripes that are bordered by dark brown, including the interspaces, lateral margins light yellow; extreme posterior point of praescutum obscure orange, not conspicuous as in *majesticus;* scutum, scutellum and center of mediotergite dark gray, parascutella light brown; sides and posterior border of mediotergite and dorsal part of pleurotergite dark brown; notal vestiture very sparse on praescutum, longer and abundant on mediotergite, still longer on scutellum. Pleura light yellow on dorsopleural region and ventral pleurotergite, slightly more intense on anepisternum, dorsal pteropleurite and pleurotergite; a narrow but conspicuous dorsal brown stripe extending from cervical region to wing base. Halteres dark brown, base of stem narrowly yellowed. Legs with coxae light yellow, anterior face of fore pair weakly more darkened; trochanters deeper yellow; femora brownish yellow, tips brownish black, relatively extensive; tibiae and tarsi similarly brownish yellow, tips very narrowly infuscated; fourth tarsal segment uniformly darkened, terminal segment light brown; claws toothed, epicondyle large. Wings relatively broad, almost uniformly rich brown; prearcular field darkened, obliterative areas restricted but conspicuous, on both sides of anterior cord; narrow brown seams on *m-cu* and adjoining medial veins and along vein *2nd A* in cell *1st A;* outer medial veins with a delicate pale brown line on either side; veins fulvous brown. Venation: R_1 at fork of R_{2+3}, R_2 obliterated or barely preserved; petiole of cell M_1 a little shorter than *m; m-cu* at near two-thirds M_{3+4}.

Abdominal tergites conspicuously dark brown, lateral borders narrowly yellowish gray; sternites light yellow, hypopygium darkened. Male hypopygium with notch of tergite relatively shallow, lobes narrowly obtuse at tips, the outer third with vestiture short, black, very abundant, margin broadly glabrous; no lateral hair pencils. Outer dististyle relatively broad at base, narrowed outwardly, apex obliquely truncate; vestiture yellow, sparse and very inconspicuous. Inner dististyle without basal lobe, before apex slightly dilated, tip narrowed, extended beneath into a small flattened blade, with a further small subterminal ventral tooth. Eighth sternite with posterior border very deeply emarginate, lobes unusually conspicuous, projecting, provided with abundant relatively short yellow setae, these narrowly lacking on midline.

Habitat: India (Assam).

Holotype: ♂, Chingsao, Manipur, 5,400 feet, 14 June 1960 (Fernand Schmid).

I take unusual pleasure in dedicating this noteworthy crane-fly to Dr. John Francis Hanson, former student and later a colleague at the University of Massachusetts. I, together with most other contributors to the *Bulletin,* gratefully acknowledge a debt of appreciation for conscientious help and advice from Dr. Hanson as Editor of the Brooklyn *Bulletin.*

The species is readily distinguished from all other regional members of the genus by the body and wing coloration and by the structure of the male hypopygium, particularly the inner dististyle and eighth sternite. Other Indian species of the *brobdignagius* group that have the eighth sternite of the male hypopygium emarginate include *Ctenacroscelis dorsopleuralis* Alexander, *C. elobatus* Alexander, *C. majesticus* (Brunetti), *C. makara* Alexander, *C. mara* Alexander, and *C. perobtusus* Alexander.

Ctenacroscelis leptostylus, n. sp.

Size large (wing of male 33 mm.); nasus short and stout; mesonotal praescutum brown with four dark gray stripes that are narrowly bordered by darker brown; pleura conspicuously striped with yellow and brown, the dorsal dark stripe narrow; femora light brown, tips narrowly and vaguely darkened; wings strongly light cinnamon brown, vaguely patterned; abdominal tergites dark brown, outer segments more cinnamon brown with a light yellow silken pubescence: male hypopygium with tergite narrow, posterior border deeply emarginate; outer dististyle narrowed outwardly, inner style very slender, gradually narrowed outwardly, at base with a small slender lobe; eighth sternite unmodified.

Male: Length about 31–32 mm.; wing 32–33 mm.; antenna about 4.4–4.5 mm.

Female: Length about 30 mm.; wing 31.5 mm.; antenna about 4.5 mm.

Frontal prolongation of head dark brown, restrictedly pruinose dorsally; nasus very short and stout, with long black setae; palpi black. Antennae with scape and pedicel buffy, the latter weakly infuscated at apex; flagellum dark brown, outer two segments darker; basal flagellar segments cylindrical, intermediate ones a trifle produced beneath, setae short and sparse. Head brown, orbits light gray, front more yellowed; vertical tubercle low, entire.

Pronotum narrowly dark brown medially, sides broadly light yellow. Mesonotal praescutum brown with four poorly defined darker gray stripes that are narrowly bordered by darker brown, the extreme lateral border yellowed; scutum brown, each lobe with three dark gray areas that are narrowly separated by brown; scutellum brownish gray, parascutella yellowed; mediotergite above light gray, the precipitous posterior part and the sides yellowed, pleurotergite similarly yellowed; vestiture of notum erect, conspicuous, more numerous on scutellum and postnotum. Pleura handsomely patterned, including a broad yellow dorsopleural stripe, beneath this with a narrow but conspicuous dark brown stripe extending from cervical region to beneath the wing root; still more ventrally, including the anepisternum, more brownish yellow; sternopleurite and lower posterior pleurites very light cream yellow. Halteres dark brown, base of stem narrowly yellowed. Legs with coxae chiefly yellowed, the anterior faces very weakly darkened, less evident on the middle pair, all coxae with long erect pale setae; trochanters yellow, patterned with brown; femora light brown, tips narrowly and vaguely more darkened; tibiae light brown; tarsi with three proximal segments light brown with darkened tips, outer two segments uniformly black; claws long, bidentate; terminal segment with a strong epicondyle provided with long black setae. Wings strongly light cinnamon brown, stigma darker; very vague darker clouds over outer end of cell *1st* M_2, fork of M_{1+2}, *m-cu* and vein *2nd A* in cell *1st A;* veins brownish yellow, the prearcular veins conspicuously blackened. Veins very glabrous, R_{4+5} with a few scattered punctures. Venation: Petiole of cell M_1 from about two-fifths to one-half *m; m-cu* at near four-fifths M_{3+4}.

Abdominal tergites chiefly dark brown, sides of basal segments more yellowed, outer tergites more cinnamon brown; basal three sternites yellowed, outer segments darkened; sixth and seventh tergites densely covered with a delicate light yellow pubescence, more apparent in certain lights. Male hypopygium with tergite very narrowly and deeply emarginate, the lobes narrowly obtuse at tips, with abundant yellow setae but without hair pencils. Basistyle scarcely produced at apex, internally with long yellow setae. Outer dististyle narrowed outwardly, apex obtuse, vestiture short and relatively sparse. Inner dististyle very slender, gradually narrowed outwardly, slightly bent beyond midlength, the apex a small flattened disk; inner face near base with a small slender lobe provided with a few black setae. Eighth sternite unmodified.

Habitat: India (Assam).

Holotype: ♂, Ukhrul, Manipur, 6,000 feet, July 15, 1960 (Fernand Schmid). *Allotype:* ♀, Langdang, Manipur, 5,300 feet, June 5, 1960 (Fernand Schmid). *Paratype:* ♂, with the allotype.

Despite its large size, the present fly seems better referred to the *albovittatus* group of the genus rather than to the *brobdignagius* group as is suggested by the size. The very short nasus and scarcely margined praescutal stripes should be noted. The fly is readily told from all other known species by the structure of the inner dististyle of the male hypopygium which is more slender than in the other described forms.

Ctenacroscelis simplicitarsis, n. sp.

Belongs to the *pallifrons* group; mesonotum virtually all orange, praescutum with three scarcely differentiated stripes; wings grayish, prearcular and costal fields a little darker but with no other pattern; male hypopygium with disk of eighth sternite bearing two large lobes, these, together with the central furrow, with abundant long yellow setae.

Male: Length about 25 mm.; wing 24 mm.; antenna about 4 mm.

Frontal prolongation of head relatively long, brownish yellow, clearer yellow on sides, ventral and outer dorsal surfaces weakly darkened; nasus elongate, tipped with short yellow setae. Antenna with scape and pedicel yellowed, proximal flagellar segments brownish yellow, slightly produced; dorsal surface with abundant short black setae, the produced lower face glabrous. Head yellow; vertical tubercle large, entire.

Pronotum yellow. Mesonotum appearing almost uniformly orange; praescutum with three scarcely differentiated stripes that are very narrowly and vaguely bordered by darker orange; sides of praescutum behind the humeri weakly infuscated; scutal lobes orange, each with two vaguely indicated areas, the larger posterior one slightly margined internally with darker, on sides beyond midlength with a small pale brown spot; scutellum yellow, sides weakly more darkened, parascutella pearly yellow; postnotum orange, yellow pollinose; praescutum with sparse erect yellow setae, those of scutellum and mediotergite similar but longer. Pleura orange yellow, propleura and ventral sternopleurite vaguely more darkened. Halteres with stem pale basally, knob darkened. Legs with all coxae orange yellow, posterior pair with very long yellow setae; trochanters yellow; femora brownish yellow, slightly darkened above at tips; remainder of legs yellowish brown; claws of male small, simple; last tarsal segment elongate, more than four times the length of the claw, without an epicondyle. Wings grayish, prearcular and costal fields, with the stigma, slightly darker; veins pale brown. Veins with the exception of costa virtually glabrous, there being a few very tiny punctures on R_{4+5} and a single series of scattered trichia on veins R, R_1, and $Sc_2 + R_1$ as far as vein R_2. Venation: R_2 obliterated, vein R_1 fusing with R_{2+3} before fork leaving a short element R_{1+2+3}; petiole of cell M_1 about two-thirds *m*.

Abdomen with basal segments yellowed, the first tergite with a darkened brown spot on either side; beyond the second segment abdomen brown; hypopygium with tergite and styli more yellowed. Male hypopygium with the tergite small, yellow, posterior margin very gently emarginate, lateral angles subacute; vestiture including a marginal fringe of delicate setulae and abundant longer setae on posterior third of plate, all hairs yellow. Outer dististyle relatively long, basal half slightly broader, apex obtuse. Inner dististyle with basal half slightly dilated into a lobe, head moderately expanded, apex irregularly subtruncate; face of style before apex ridged, one of these extended to a slender free spine. Eighth sternite with posterior border convexly rounded, fringed with long yellow setae; disk back from margin with two large lobes, their obtuse tips darkened, inner margins and the broad midventral furrow with abundant long yellow setae.

Habitat: India (Assam).

Holotype: ♂, Phaileng, Mizo District, Lushai Hills, 3,500 feet, 14 Sept. 1960 (Fernand Schmid).

The only other described regional ally is *Ctenacroscelis pallifrons* Edwards, of the eastern Himalayas in North Bengal and Sikkim, which likewise has the claws of the male small and simple, with the elongate terminal tarsal segment lacking an epicondyle. All other Asiatic species known to me have the claws of male very long, bidentate, and with the last tarsal segment produced into a well-developed basal hairy enlargement, the epicondyle. The present fly is readily told by the unpatterned wings and by the hypopygial structure, especially the eighth sternite, where the discal lobes are very large when compared with *pallifrons*. It may be noted that in *pallifrons* there is no clearly defined ventral furrow, the central sternal vestiture consisting of long dark colored setae. The South African *Ctenacroscelis quathlambicus* Alexander likewise has simple male claws but apparently must be referred to a distinct group in the genus.

AN AID FOR PARAFFIN EMBEDDING

By Wm. B. Nutting[1]

Equipment on the market for paraffin embedding of tissues for section is not only expensive, but very time-consuming in application. Conventional folded paper boxes or lead L's are useful for an occasional tissue, but both require a great deal of preparation prior to and during the embedding-to-mounting process. Expense and lost time are especially irksome for laboratories in which small budgets and moderate or spasmodic sectioning needs are of prime concern.

This note describes an easily constructed low-cost paraffin embedder which reduces by about one-half the time usually spent in preparing tissues for sectioning.

Construction

Only three items are needed to construct the embedder: Plaster of Paris, modelling clay, and the top of a standard ½ gross microscope slide box (3 3/16″ × 3 3/16″ × ⅞″). First prepare four truncated pyramids of modelling clay approximately ⅝″ high with bases 1″ square and tops ½″ square. These are each positioned with the base down midway along the side of the inverted slide box cover. Next, carefully model five clay replicas of a ready-to-section paraffin block—precision at this point will save block trimming in the final product. Then mix the plaster to the usual cream-soup consistency and pour it into the box top. Press the clay models into the plaster, one in the center and one in each corner. Be sure that about 3/16″ of plaster remains between corner models and the edge of the slide box. After the plaster has set, peel off the slide box and remove the modelling clay. Smooth up the embedding pits with a scalpel and cut ¼″ deep V-shaped grooves between corner pits and center pit (see Figure). It is also feasible to cut the top of the pit walls to fit wooden mounting blocks. These are then placed in position just after securing the designation slips (below) thus eliminating one step later in the process.

The embedder design is easily modified to meet special requirements such as: size and shape of tissue and number of tissues per embedder. One may also construct simple trays so that several embedders may be handled and stored at one time.

Procedure

Soak the embedder in room temperature (20° C) water prior to use taking care that no excess water remains standing in the block pits. Pour embedding paraffin into the central pit until all pits are filled to the brim. Embed the tissue and place designation labels in the surface paraffin. These labels may be so arranged that they can be bent and paraffin-affixed to the side of the mounting block. Before the paraffin sets the embedder is placed in the refrigerator (c. 7° C). In about one hour paraffin blocks, ready to mount and slice, will pop out of the embedder (see Figure) with only slight encouragement. It is recommended that blocks be stored overnight in the refrigerator before slicing to insure complete hardening of the paraffin in the tissue.

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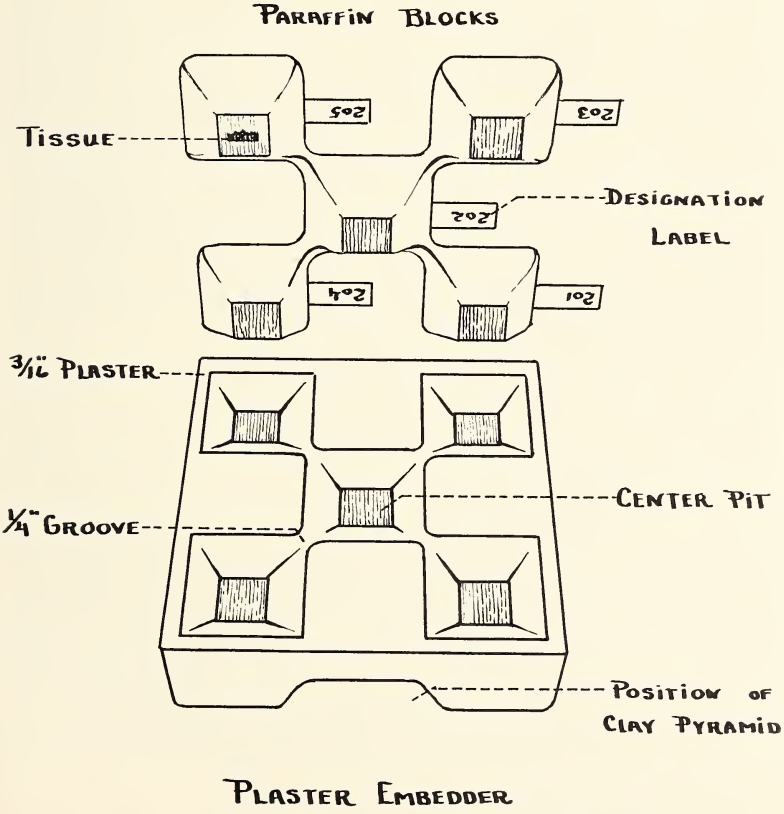
[1] Zoology Dept., Univ. of Mass., Amherst, Massachusetts.

In brief

This tissue embedder can be constructed in about one half hour at a cost of approximately twenty five cents. It is permanent, needs no maintenance, cuts paraffin waste, obviates messy ice cube manipulation, and reduces the usual oven-to-slicing time by at least one-half.


PARAFFIN BLOCKS
TISSUE
205
203
202
DESIGNATION LABEL
204
201
3/16" PLASTER
1/4" GROOVE
CENTER PIT
POSITION OF CLAY PYRAMID
PLASTER EMBEDDER

THE IDENTITY OF LUTZOMYIA CURRAN (DIPTERA)

By Curtis W. Sabrosky[1]

Lutzomyia americana Curran, new genus and new species (1934, Families and Genera of North American Diptera, pp. 387, 396, 398) were proposed briefly in couplet 11 of the key to Muscidae, supplemented by a three-line footnote and figures of the head and wing. The genus was referred to the subfamily Eginiinae, an Old World group not otherwise known from North America. Thus far it has not been recognized, but two syntypes were recently located by Dr. Paul H. Arnaud, Jr., in the collection of the American Museum of Natural History, and kindly loaned to me for study. It appears that *Lutzomyia,* preoccupied and renamed *Pseudolutzomyia* by Rapp in 1945, equals *Bezzimyia* Townsend (1919, Proc. U. S. Natl. Mus. 56: 591) [**New Synonymy**], although *americana* is somewhat atypical in the genus. *Bezzimyia* was placed by Townsend in the family Melanophoridae, which I consider to be the primitive subfamily Rhinophorinae in the Tachinidae.

Inadvertently, two specific names were used by Curran in the original publication of *Lutzomyia, americana* in the footnote on p. 387, and *latifrons* in the legends of figs. 52 and 59 (pp. 396, 398). As first reviser, I reject the alternate name *latifrons,* and choose to call the species *Bezzimyia americana* (Curran) [**New Combination**].

In view of the brevity of the original description, it is appropriate to redescribe the specimen which is here designated as lectotype of *Lutzomyia americana* Curran.

Male.—Black or black brown, subshining though finely pollinose, the second and third antennal segments luteous, first segment and arista brown, front anteriorly reddish yellow, palpus luteous, stalk of halter pale yellow, wing light brown with dark brown veins, calypteres whitish.

Head teneral and slightly collapsed, but the front apparently wider than an eye; frontal triangle, including ocellar tubercle, rather large, extending over half the length of front; each shining parafrontal slightly less than width of frontalia, possibly subequal or wider in a mature specimen; head in profile as figured by Curran (p. 396, fig. 52), higher than long, antennal axis longer than vibris-

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[1] Entomology Research Division, Agricultural Research Service, U. S. Department of Agriculture, Washington, D. C.

sal axis, and cheek approximately half the height of an eye; face deeply depressed; antenna long, attaining level of vibrissal angles, the proximal two segments short, the third elongate, 7 times the length of second; arista thickened to tip, gently tapering, both proximal segments short. Bristles short and inconspicuous, the proclinate and divergent ocellars almost hairlike, the row of 5 frontals and the verticals somewhat stronger; coarse parafrontal hairs extending ventrad onto parafacials to below the level of base of arista; back of head with scattered coarse black hairs; vibrissal angle with a group of about 6 subequal bristles, and finer and shorter bristles extending over half way up the facial ridges, the upper bristles extremely short.

Thorax relatively narrow, the mesonotum 4/5 as broad as long, with strong mesonotal suture and conspicuous humeri; scutellum short, rounded; postscutellum narrow, weakly developed; dorsum with coarse but short black hairs; prosternum, propleuron, and pteropleuron bare. Chaetotaxy: 2 humeral, 1 (or more) anterior and 4 posterior dorsocentrals (only the prescutellar pair strong), 1 posthumeral, 1 supraalar, 1 + 1 notopleural, 1 apical and 1 subapical scutellar, 1 propleural, 1 stigmatal, 3 mesopleurals in row along hind margin (with scattered, coarse hairs), a row of strong hypopleurals (2 on left side, 4 on right), and possibly 2 sternopleurals (the sternopleurals are reduced and not readily distinguished from the coarse hairs).

Abdomen with segments 2 to 5 subequal in length, with scattered coarse hairs but without obvious bristles; fifth sternum large, with rounded lobes. Genitalia (from paralectotype) as in *B. busckii*: Inner forceps bifurcate, slightly curved in profile, broadened at base, slightly shorter than outer forceps, the latter subtriangular, broadly rounded; aedeagus slender, distal portion on each side with a slender process at right angle to long axis of aedeagus.

Wing venation as figured by Curran (p. 398, fig. 59), but the hind crossvein straight, parallel to course of fore crossvein and forming angle of about 80° with fifth vein; calypteres narrow and somewhat elongate, as in *Melanophora roralis* (L.), but longer, the thoracic calypter approximately 1.5 times as long as broad.

Legs slender, tarsi compressed and especially elongate, the fore tarsus 1.27 times the length of fore tibia; fore basitarsus long, 0.87 times the length of the remaining segments combined; claws and pulvilli short, barely 1/3 the length of last tarsal segment; femora and tibiae thickly beset with short appressed hairs, bristled only at apices of tibiae, except for a very short anterodorsal bristle slightly beyond middle of left hind tibia.

Length of body and of wing, 5 mm.

Lectotype male, Santa Cruz Village, Cobabi Mts., Ariz., 10–12 Aug. 1916, 32° 1′ N., 111° 54′ W., about 3100 ft. Paralectotype male, "Kits Peak Rincon," Baboquivari Mts., Ariz., 1–4 Aug. 1916, 31° 57′ N., 111° 33′ W., about 4050 ft. Both in the American Museum of Natural History.

I have studied five specimens of the genus: the lectotype and paratype of *americana,* the holotype male of the type-species, *B. busckii* Townsend, described from Panama, and two females, probably *busckii,* from Brownsville, Tex., one collected locally and one intercepted in a plane from the Panama Canal Zone. Figures of the head and wing of *busckii* were published by Greene (1934, Proc. Ent. Soc. Wash, 36: 37, 38), and may be compared with Curran's figures for *americana.*

The two species may be separated as follows, using characters that will be common to both sexes as indicated by the available material of *busckii.*

1. Arista thickened no more than half way to tip; crossveins approximated, separated at most by length of fore crossvein; wing with short brown band enclosing the crossveins; two short pteropleural bristles .... *B. busckii* Tns.
   Arista thickened to tip; crossveins more widely separated, by twice the length of fore crossvein; wing membrane clear; no pteropleural bristles .... *B. americana* (Curran)

In addition to the characters used in the key, the male of *americana* is distinguished by a broad front, wider than an eye, whereas the male of *busckii* has a narrower front, slightly less than half the width of an eye. The specimens of *americana* are teneral, as the appearance of the head indicates, and in mature specimens the front would undoubtedly appear narrower than it now does. The apparent absence of leg bristles, noted by Curran for *americana,* is a matter of reduction, and of variation. *B. busckii* has some short bristles on femora and tibiae. The lectotype of *americana* has only a very short bristle on one hind tibia, but the paralectotype has 4 or 5 short but distinct anterodorsal bristles on the right hind tibia and 1 on the left.

The characters of head and calypteres, in particular, resemble those of typical melanophorine genera. The nearest known relative of *Bezzimyia* appears to be *Shannoniella* Townsend (1939, Revista Ent. 10: 249), from Brazil, for which Townsend proposed the tribe Shannoniellini of his family Melanophoridae. The head in *Shannoniella* is like that of *B. americana,* with broad male front and thickened arista, but the fourth vein is complete, there are 2–3 weak pteropleural bristles as in *B. busckii,* and the femora and tibiae have short, weak bristles. The African genus *Bequaertiana* Curran (1929, Amer. Mus. Novitates 340: 14) is another in the same tribe. It has an incomplete fourth vein as in *Bezzimyia,* and a wide male front, but it has peculiar characters of its own such as plumose arista and setose first vein. As in *Bezzimyia americana,* I see no evidence of pteropleural bristles in the sole example of *Bequaertiana* before me, and none are mentioned in the available descriptions. *Trypetidomima* Townsend (1935, Revista Ent. 5: 68) from Brazil can also be referred to this tribe.

NEW SPECIES OF HYDROPTILIDAE (TRICHOPTERA)[1]

By R. L. Blickle, Durham, New Hampshire

Five new species of Hydroptilidae were encountered in a recent survey of light trap material from the State of Maine. The material was furnished through the kindness of Dr. A. E. Brower. The survey covered a six week period during July and August, 1959. Most localities were from the Boreal region.

Holotypes and paratypes will be placed in the Illinois Natural History Survey Collection and paratypes will be retained in the collection of the University of New Hampshire.

Hydroptila jackmanni, n. sp.

Male.—Length from front of head to tip of wings 2.5–3.0 mm. Seventh sternite with a short, pointed apico-mesal process. Eighth segment is covered with long hairs on apical one-fourth. Genitalia as in Fig. 1. Lateral view, Fig. 1A, has been drawn with the terminal segments protruding to better illustrate the genitalia. Claspers, in lateral view, are C-shaped; upper arm of clasper wider than lower; a small, black protuberance at apical one-third of the ventral surface of upper arm. Ventral view, Fig. 1C, the tips of the lower arms meet on the meson and form a "V" when seen in this view; upper arms flare out, the tips are further apart than the base. From a posterior view the upper arms of the clasper are inclined at an angle of forty-five degrees, the mesal edge being lower than the ectal edge. Tenth tergite, Fig. 1A, tapers irregularly from base to apex; lateral edges are sclerotized to a greater degree than rest of tergite; a narrow ridge extends down the dorsum; area between the dorsal ridge and lateral edges irregularly concave. Subgenital plate broadly triangular with two setae near apex, Fig. 1C.

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[1] Published with the approval of the Director of the New Hampshire Agricultural Experiment Station as Scientific Contribution No. 296.

Aedeagus, Fig. 1B, 0.4 mm. long; basal and apical parts are of equal length; a small spiral process occurs between apical and basal parts; tip of aedeagus appears forked in some views.

This species is quite distinct from the other members of the genus.

Holotype Male.—Dennistown, Maine, 19 July 1959.

Paratype Males.—Dennistown, Maine, 14–31 July 1959, 100 specimens.

Other records.—Allagash, Maine, 5–29 July 1959, 3 specimens; Dennistown, Maine, 14–31 July 1959, 3,674 specimens; Oquossoc, Maine, 19 July–4 Aug. 1959, 35 specimens; Colebrook, New Hampshire, 25 June–29 July 1957, 28 specimens.

Hydroptila broweri, n. sp.

Male.—Length from front of head to tip of wings 2.2–2.8 mm. Seventh sternite with a short, pointed apico-mesal process. Eighth segment with numerous, long, heavy hairs on the apical sixth, these hairs concealing the genitalia; eighth segment with a pigmented area on dorsum indicated by a single dotted line, Fig. 2A. Genitalia, Fig. 2, in lateral view, the claspers are widest at base; however, the rounded apex is slightly wider than the main body of the clasper; a dark protuberance occurs at the apical seventh on the ectal surface. Ventral aspect, Fig. 2C, claspers appear broad, small hairs cover the lateral and ventral surfaces of the claspers. Tenth tergite is composed of one central and two lateral parts; the central part is large and extends nearly one-half again beyond the apex of the claspers; the central portion appears upcurved at apex; lateral parts of tenth tergite extend to just beyond the claspers; apex of lateral parts appear truncate and pigmented in Fig. 2A. Ventral aspect, the lateral arms are excavated at the apex and the ectal margins are pointed. Subgenital plate is triangular with two setae near the apex.

Aedeagus, Fig. 2B, 1.0 mm. long; in most specimens the apical part is bent to one side; the base is very long, over twice the length of apical part; tip of aedeagus curved, a tubular structure extends beyond tip. The very long aedeagus is quite apparent in cleared and uncleared specimens.

This species is similar to *H. scolops* Ross. However, the very long aedeagus, the parts of tenth tergite being shaped differently, and the tooth on the clasper occurring before the apico-lateral edge, serve to distinguish *browerі*.

Holotype Male.—Allagash, Maine, 26 July 1959.

Paratype Males.—Allagash, Maine, 22 July–2 Aug. 1959, 53 specimens; Dennistown, Maine, 14–25 July 1959, 21 specimens; Oxbow, Maine (T9 R5), 19 July–4 Aug. 1959, 4 specimens; Oquossoc, Maine, 17–31 July 1959, 20 specimens; Tramway, Maine, 3 Aug. 1959, 1 specimen; Colebrook, New Hampshire, 5–29 July 1957, 5 specimens.

Hydroptila fiskei, n. sp.

Male.—Length from front of head to tip of wings 2.6–3.0 mm. Seventh sternite with a very long apico-mesal process. Genitalia, Fig. 3. Claspers are short, curved downward at apex; ventrally, Fig. 3C, claspers are approximate on the meson from base to apex. Tenth tergite widest at base, Fig. 3D, and tapers gradually to rounded apex; apex appearing slightly bilobed; in lateral view the slope of the tenth tergite is straight from base to apex, however, in some specimens the apical one-seventh is at a flatter angle than the basal part of the tergite.

Aedeagus, 0.8 mm. long, Fig. 3B. Apical part sharply bent at tip; a long slender tubular structure extending to tip or slightly beyond; a short slender structure near base of apical part; the spiral process is short, apparently making no more than one revolution around aedeagus.

This species is closely related to *H. hamata* Morton and *H. ampoda* Ross. It is distinguished from the above two species by the following. In *hamata* the tenth tergite is concave in profile, and in dorsal aspect is widest at the middle; the tip of the claspers do not meet on the meson. In *ampoda* the tenth tergite is concave in profile, the aedeagus has an entwined spiral process, and the tip of the aedeagus is not bent at an angle.

Holotype Male.—Dennistown, Maine, 17 July 1959.

Paratype Males.—Allagash, Maine, 29 July–2 Aug. 1959, 13 specimens; Dennistown, Maine, 15–28 July 1959, 33 specimens; Oquossoc, Maine, 17 July–4 Aug. 1959, 4 specimens; Oxbow (T9 R5), Maine, 4 Aug. 1959, 2 specimens.

Oxyethira allagashensis, n. sp.

Male.—Length from front of head to apex of wings 2.5–3.0 mm. Seventh sternite with a short apico-mesal process. Genitalia, Fig. 4; claspers short, pointed with apex pigmented and upcurved in lateral view, Fig. 4A. The appearance of the claspers and subgenital plate, lateral aspect, gives the effect of pincers. In Fig. 4C, the claspers are pointed towards the meson and the subgenital plate appears as an ovate plate.

Aedeagus, 0.5 mm. long; tip of aedeagus appears membranous; the spiral process in most specimens makes at least two complete revolutions around the apical part and extends beyond the apex of the aedeagus; the revolutions of the spiral process may be separated as drawn, Fig. 4B, or the turns of the process may be appressed together.

This species is related to *O. rivicola* Blickle & Morse but lacks the heavy spine on the apico-lateral margin of the eighth segment. The subgenital plate is not indented as it is in *rivicola.*

Holotype Male.—Allagash, Maine, 29 July 1959.

Paratype Males.—Allagash, Maine, 24 July–2 Aug. 1959, 23 specimens; Oquossoc, Maine, 28 July 1959, 1 specimen.

Ochrotrichia wojcickyi, n. sp.

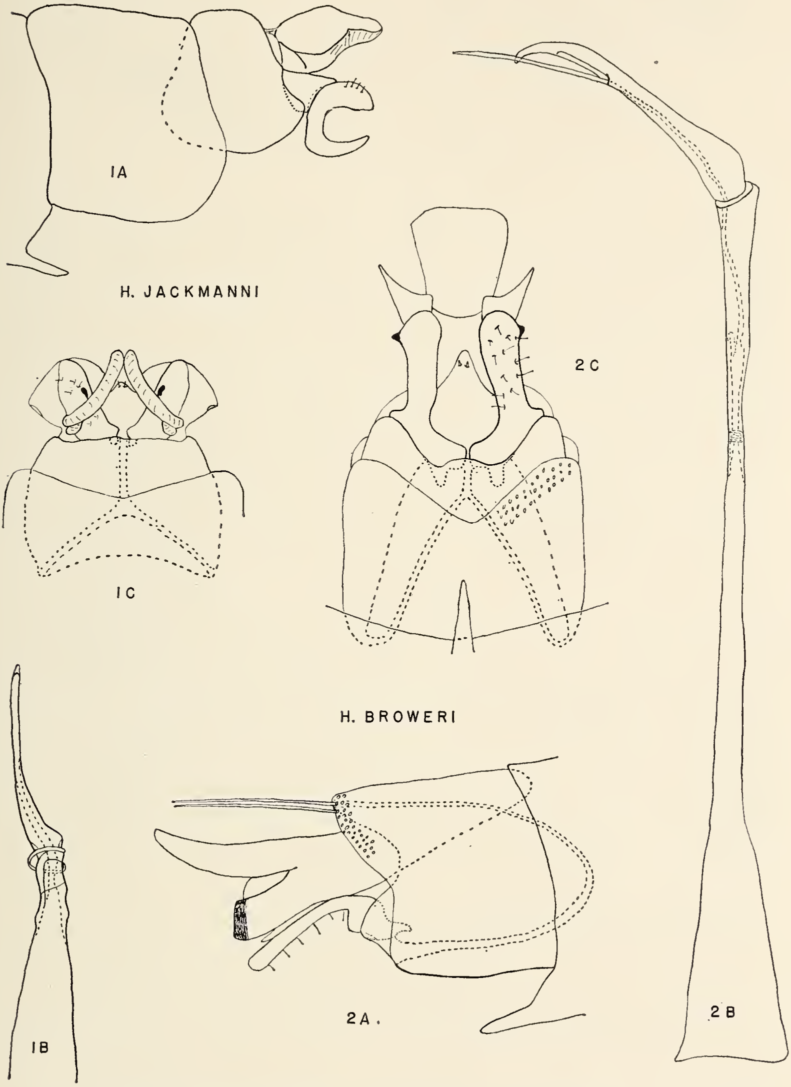
Male.—Length from front of head to apex of wings 2.6–3.0 mm. Genitalia, Fig. 5. Tenth tergite, apical portion divided into sclerotized rods. Dorsal view, Fig. 5D, rod A is hooked at apex; rod B is quite short, broad at base, and pointed at the apex; rod C is long and tapers to an acute point; the bases of A, B, and C arise from approximately the same area; rod D appears short but in lateral aspect, Fig. 5A, it is long and down-curving; rod E is long and pointed, its base approximate with D. Claspers are nearly symmetrical with pointed, toothed apex and notched mesally; with a variable number of teeth near the notched area and several teeth between notch and apex.

This species is closely related to *O. lometa* Ross and *O. logana* Ross, being quite similar in the shape and number of sclerotized rods and the shape of the claspers. However, the above two species were described from New Mexico and Utah, respectively.

Holotype Male.—Dennistown, Maine, 25 July 1959.

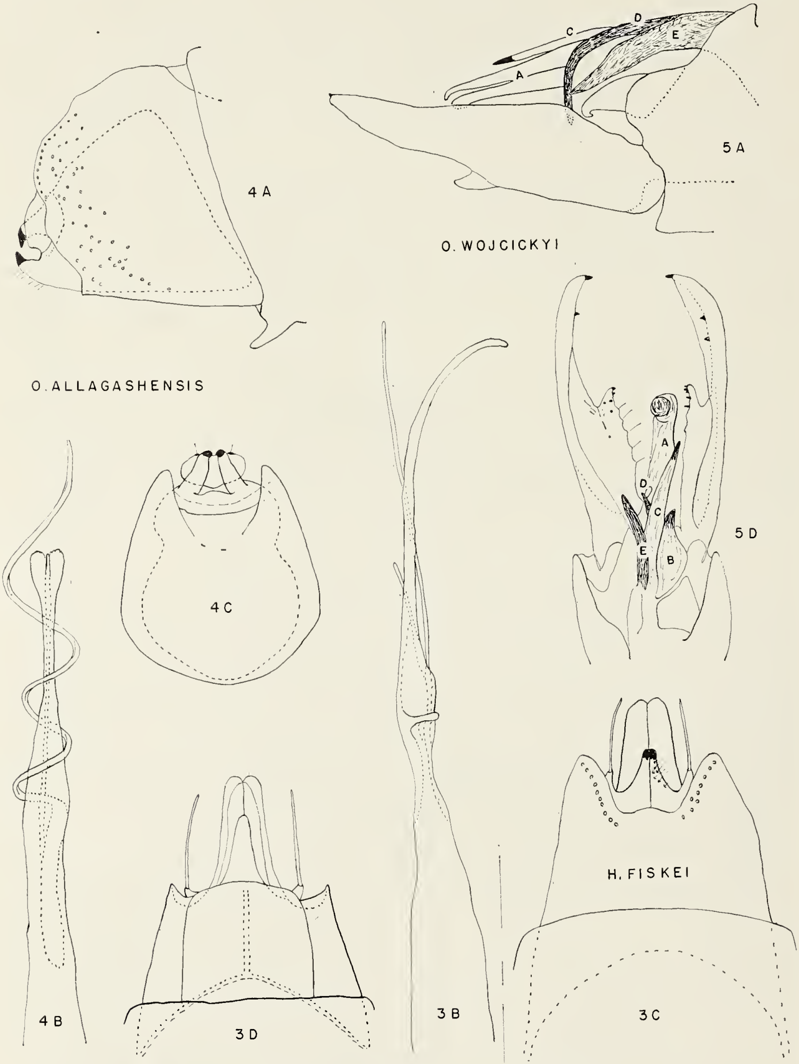
Paratype Males.—Dennistown, Maine, 24–31 July 1959, 8 specimens; Oquossoc, Maine, 28 July 1959, 1 specimen.

BLICKLE PLATE I


1A
H. JACKMANNI
1C
1B
2C
H. BROWERI
2A.
2B

Hydroptila male genitalia. A, lateral. B, aedeagus. C, ventral. D, dorsal.

Blickle Plate II


C
D
E
A
5A
4A
O. WOJCICKYI
O. ALLAGASHENSIS
A
D
C
E
B
5D
4C
H. FISKEI
4B
3D
3B
3C

Hydroptila, Ochrotrichia, and *Oxyethira* male genitalia.

ASIAN *MACROCERA* MEIGEN, 1803, (DIPTERA: MYCETOPHILIDAE), WITH SOME REMARKS ON THE STATUS OF THE GENUS AND RELATED GENERA[1]

By Edward I. Coher[2]

Abstract

Nine species of *Macrocera* (Diptera: Mycetophilidae) are discussed. Five of these are described for the first time: *M. nepalensis, M. trispina* and *M. vishnui* from males only; *M. simbhanjangana* from males and females and *M. femina* from a single female. The first four of these are from Nepal, the last from Thailand. *M. crassicornis* Winn., 1963, is reported from Afghanistan. The male of *M. brunnea* Brunn., 1912, and the female of *M. elegans* Brunn., 1912, are described and the description of the female of *M. elegans* Brunn. is augmented. The genus *Fenderomyia* Shaw, 1948, is synonymized under *Macrocera*. The genus *Neoditomyia* Lane and Sturm, 1958, is synonymized under *Platyura* (*Taulyrpa*) Edwards.

Introduction

Included in a collection of fungus gnats made in Nepal, Thailand and Afghanistan, by myself and my co-workers, is a series of species of the genus *Macrocera*. The material includes three Nepalese forms which I consider to be conspecific with species described by Brunetti (1912). One species from Afghanistan represented by a single male is apparently conspecific with a European species. A striking new species from Thailand is represented by a single female. Four new species from Nepal are represented either by males or by males and females.

In Nepal, some of the species were collected in the Rapti Valley (520m.) which lies in the 'terai' of south central Nepal between the Siwalik and the Mahabharat Ranges.

At the higher altitude of Simbhanjang (Sim Pass, Nepal) at 8190 feet in a cloud forest of moss-covered rhododendron trees, snow and ice may be present for several months of the year and rain is the normal collecting hazard.

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[2] 599 Main St., Waltham 54, Mass.

The systematic position of the genus *Macrocera* in relation to the family Mycetophilidae is now well established by the work of modern students of the group. On the basis of adult structural characters (Edwards, 1929a; Lane, 1950; Shaw and Shaw, 1951) the genus belongs within the subfamily Keroplatinae. Edwards, in discussing *Platyura* (*Isoneuromyia*) and *P.* (*Pyrtaula*), wrote "This type of hypopygium is identical with that which occurs in the genera *Macrocera* and" etc. In 1949, I started a study of *Macrocera* adults which caused me to conclude that this genus was indeed a keroplatine and the material was turned over to Prof .J. Lane who concurred with the findings and described the species in his paper "Neotropical Ceroplatinae". Shaw and Shaw, commenting on the form of the pleural sclerites, wrote "*Macrocera* on the basis of thoracic sclerites is intermediate between *Palaeoplatyura* and *Platyura*. - - -. *Macrocera, Proceroplatus, Platyura* and *Ceroplatus* all exhibit one characteristic in common—the reduction of the lower portion of the epimeron of the mesothorax. - - -. Our present opinion would be that the Macrocerinae should be included in the Ceroplatinae".

Supporting evidence for the above contention is found in a reevaluation of earlier studies of the anatomy and the bionomics of the larval stage (Mansbridge, 1933; Madwar, 1935, 1937; Enslin, 1906). As far as I am able to determine, only the keroplatines build complicated webs with droplets of fluid [shown to be N/30 oxalic acid for some *Platyura* by Buston (1933)] in which they trap their prey.[1] The larvae have been observed attacking and feeding on live prey and thus must be predaceous rather than saprophagous (Farr, 1955; Mansbridge, 1933; Spangler (personal communication; Enslin, 1906). The retractile head, the deep emargination of the ventral portion of the head capsule, the proportion of length to width of the head capsule (as long as or longer than wide), the hood-like labrum, the presence of prominent circular areas on the head capsule rather than antennae, the absence of functional spiracles, and the papillate condition of the terminal segment all indicate the relationship of *Macrocera* to other keroplatines (Edwards, 1933).

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[1] Study of the descriptions of two web-spinning species, *Neoditomyia andina* Lane and Sturm, 1958, and *N. colombiana* Lane and Sturm, 1958, convinces me that these are actually *Platyura* (*Taulyrpa*). Thus, the keroplatines remain the only group with a predaceous larval stage that spins webs with fluid droplets to capture prey. **New Synonymy.**

Related genera are: *Paramacrocera* Edwards, 1927, originally described from New Zealand and later recorded from Chile by Freeman, 1951; *Chiasmoneura* de Meijere, 1913, Java; *Burmacrocera* Cockerell, 1917, described from Burmese amber, and later recorded from Philippines by Edwards, 1929b; *Archaemacrocera* Meunier, 1917, Baltic amber. Meunier's illustrations of the genotype indicate that *Archaemacrocera* is a synonym of *Macrocera*. However, I have not seen the type and therefore I cannot make a final judgment. *Fenderomyia* Shaw, 1948, is based on an erroneous interpretation of the pleural sclerites, a variable condition shown by a series of *M. brunnea* Brunetti, 1912, to be a result of distortion during drying rather than of actual structure. The petiole of the media ending at the base of M_4 as in *Fenderomyia* is a condition that also occurs in *M. alternata* Brunetti, 1912, an Asian species, and also in *M. crassicornis* Winnertz, 1863, a European species. The produced costa of *Fenderomyia* occurs in several species of *Macrocera* discussed and described (see Pl. 2) in this study: **New Synonomy.**

In the following descriptions, the wing venation terminology is in accordance with Coher (1959). The dististyles which are compressed laterally are figured in broad lateral view which I presently consider to be most diagnostic for the species. The appearance of the dististyle varies greatly as it is rotated around its longitudinal axis. The term genital arch is introduced to name a sclerotized median cup-shaped sternal structure which appears broadly V-shaped from the dorsal or ventral view. Apparently it supports the basistyles and the ejaculatory duct; at present I am unable to determine its homology and it is not figured for any of the species although it is described in the text.

All specimens were collected by myself unless otherwise stated. The types are preserved in my collection.

1. *Macrocera alternata* Brunetti, 1912.

Brunetti, 1912, Fauna Brit. India: 52, pl. 1., fig. 2; male, female (Naini Tal, 6000′, Mussoori).

Brunetti, 1917, Rec. Indian Mus. 13, Pt. 2: 61; female (Simla).

Diagnosis.—I have a single female specimen which agrees well with the original description of *alternata*, the following differences being noted: first flagellar segment yellow; abdominal segments one to three narowly dark on posterior margin. In addition, the following diagnostic characters are noted for the first time: ocellar prominence black; upper anepisternum with a cluster of setae; acrostichal setae absent; wing membrane without macrotrichiae; wing (Pl. 2) with costa barely produced beyond tip of R_5, Sc enters costa at level of anastamosis, R_{1+2+3} swollen apically and entering costa halfway between fM_{1+2} and fR_{4+5}, no wing fold in cell R_3, M not fused with Rs and reaching to m-cu, M_{1+2} shorter than anastamosis, tips of M_1 and M_2 not divergent, Sc apically setose, R_{1+2+3}, R_{4+5}, R_4, R_5, M_1, M_2, M_4 and Cu_1 setose almost entire length. Male terminalia are not available for illustration.

New Record.—**Nepal**, Suna Chudi (Rapti Valley), 520m., 23 March 1957 (E. I. Coher and G. P. Joshi), 1♀.

Discussion.—I have seen the wing of the type of *M. ephemeraeformis* Alexander, 1923, from Japan. The wings are strikingly similar except for the larger size of the Japanese species, the comparatively greater distance that the costa is produced beyond the apex of R_5, and the entry of Sc into the costa just beyond the anastamosis. It is probable that *M. ephemeraeformis* Edws. (nec Alex.) 1933, from North Borneo, is one of a series of species related to *alternata.*

Comparison of the Brunetti types with my specimen may show that different but closely related species are involved. The types were taken at high altitudes during and immediately after the rainy season while my specimen was taken at a much lower altitude during the dry season.

2. *Macrocera brunnea* Brunetti, 1912.

Brunetti, 1912, Fauna Brit. India: 53, pl. 1, fig. 5; 2 females (Phagu, 9000′).
Brunetti, 1917, Rec. Indian Mus. 13: 61.
Edwards, 1924, Rec. Indian Mus. 26: 291.

I have a series of seven specimens taken in the low-lying jungle bordering India (terai), five males and two females. The male is here described and illustrated for the first time.

Male.—*Head:* reddish brown; antenna brown, about four times body length, scape and pedicel yellow brown. *Thorax:* yellowish, anepisternum and katepisternum a little darker; acrostichal and dorsocentral setae absent; upper anepisternum with a couple of setae. *Wings:* (Pl. 2); apex faintly suffused from just beyond apex of R_4; dark cloud from costa through apex of R_{1+2+3} reaching R_{4+5}, lightly suffused through anastamosis and into base of cell R_5 through M_4 to bend in Cu_1; membrane with macrotrichiae in cells R_4 and apically in R_5, M_1 and M_2; costa not produced beyond tip of R_5; Sc enters costa at level of anastamosis; R_{1+2+3} swollen apically and entering costa at apex of R_4; slight suggestion of a fold in cell R_3; M ending in Rs; M_{1+2} longer than anastamosis; tips of M_1 and M_2 diverging slightly; Sc, R_{1+2+3} and R_4 setose; M_1 and Cu_1 with more than distal half setose and M_2 and M_4 with less than distal half setose; length 4.75mm. *Haltere:* yellowish. *Legs:* yellowish, tibial spurs subequal, apical comb on foretibia. *Abdomen:* yellowish; SVIII shaped like a papal miter. *Terminalia:* TIX subrectangular; genital arch broadly V-shaped, lightly pigmented; dististyle as in Plate 1.

Female.—Similar to male. In addition to the original description, the following characters are noted: acrostichal setae absent, dorsocentral setae present; wing membrane with macrotrichiae in apical half of cell R_3 and all of cell R_4, along a median line in basal portion of cells R_5, M_1 and M_2, and scattered distally in cells M_4, Cu_1, Cu_2 and 1st A.

Allotype male.—**Nepal**, Suna Chudi, 520m., 23 March 1957.

Additional records.—**Nepal**, Parewavir, 570m., 28 March 1957, 2♂♂ 1♀; Parewavir, 570m., 3 April 1957 (E. I. Coher and G. P. Joshi), 1♂ 2♀♀.

Discussion.—The anal angle of the wing is normally 'squared' in my specimens, not as figured by Brunetti.

3. *Macrocera elegans* Brunetti, 1912.

Brunetti, 1912, Fauna Brit. India: 54, pl. 1, fig. 4; male (Darjiling).
Edwards, 1924, Rec. Indian Mus. 26: 291.

A male and female of this species were taken in the Mahabharat Range. The female is described and the male terminalia figured for the first time.

Female.—*Head:* red brown; antenna yellowish. *Thorax:* yellow brown; anepisternum, katepisternum, posterior pleurotergite, median area of scutellum and the postnotum red brown; mesonotum with median dark triangular area the apex of which nearly attains the posterior margin, with two lateral dark stripes from scutellum not reaching humeral angle; acrostichal setae absent; upper anepisternum with a cluster of setae. *Wing:* (Pl. 2); apex suffused from halfway in cell R_4 to midway in cell M_1 and caudad along wing margin to apex of vein M_2, and from costa through apex of R_{1+2+3} and through anastamosis and fM_{1+2}, narrowing to reach bend of Cu_1; base of wing suffused; membrane without macrotrichiae; costa produced one-third length of margin of cell R_5 beyond tip of R_5; Sc enters costa almost at level of distal part of m-cu; R_{1+2+3} swollen apically and entering costa the length of M_{1+2} beyond fM_{1+2}; a short fold in cell R_3; M ending free at level of bend in Rs; M_{1+2} longer than anastamosis; tips of M_1 and M_2 slightly divergent; Sc, R_{1+2+3}, R_4, R_5, M_1, M_2, M_4, Cu and Cu_1 setose; length 5.5mm. *Haltere:* yellowish. *Legs:* yellow; midcoxa and apex of hind coxa suffused; apical comb on foretibia; tibial spurs subequal.

Male.—A single specimen agrees well with the original description and Edwards' correction (1924) except that R_{1+2+3} enters the costa the length of M_{1+2} beyond fM_{1+2}. Also, the anterior as well as the posterior margins of the abdominal tergites are darkened irregularly. In addition to the original description, the following diagnostic characters are noted: acrostichal setae absent; R_{1+2+3}, R_5 and M_1 setose while R_4, M_2, M_4 and Cu_1 have a couple of apical setae; SVIII shaped like a papal miter; TIX subrectangular; genital arch almost bracket-shaped with deep median posterior emargination; dististyle as in Plate 1.

Allotype female.—**Nepal**, Mahabharat Range, Simbhanjang 8190′, 1 Oct. 1956 (E. I. Coher and G. P. Joshi).

Additional specimen.—One male with same data as allotype (E. I. Coher and Pratap Singh).

Discussion.—The Brunetti specimen apparently differs only in the length of R_{1+2+3} which enters the costa basad of M_{1+2}. The allotype was taken in an unbaited Shannon trap.

4. **Macrocera nepalensis,** n. sp.

Male.—Head: yellowish except for brownish vertex and black ocellar prominence; palpus brownish; antenna yellow brown, about four times body length, with basal flagellar segments, scape and pedicel yellow, with the first three flagellar segments shorter than the following nine and the last two short. *Thorax:* yellow brown; an elongate brown mark on edge of mesonotum in front of wing and at humeral angle; acrostichal setae absent; anepisternum with a couple of setae at upper margin. *Wing:* (Pl. 2); apex suffused; suffused at tip of R_{1+2+3}, at base of Rs and from base of R_{4+5} caudad through fM_{1+2}, narrowing and reaching bend of Cu_1; membrane without macrotrichiae; costa produced well beyond R_5; Sc meets costa barely beyond base of Rs; R_{1+2+3} swollen apically and meeting costa about the length of M_{1+2} before the apex of R_4; no fold in cell R_3; M fused with Rs at bend; M_{1+2} longer than anastamosis; tips of M_1 and M_2 curving in the same direction; Sc bare; R_{1+2+3}, R_{4+5}, R_4 apically, R_5, M_1, M_2, M_4 and Cu_1 setose; length 4.25mm. *Haltere:* yellow. *Legs:* yellow; mid and hind coxae slightly darkened; tibial spurs subequal; apical comb on foretibia. *Abdomen:* yellow brown; SVIII shaped like a papal miter. *Terminalia:* TIX subrectangular; genital arch apparently broadly V-shaped with a deep median posterior emargination; dististyle as in Plate 1.

Holotype male.—**Nepal**, Suparitar, 650m., 8 Dec. 1956.

Discussion.—This species has a superficial resemblance to *M. brunnea* but differs in the form of the terminalia and a number of characters of the wing.

5. **Macrocera trispina,** n. sp.

Male.—*Head*: reddish brown, blackish around ocelli; palpus reddish brown; antenna brown, with first flagellar segment, scape and pedicel yellowish; antenna broken, at least three times length of body, segments increasing in length through the tenth flagellar segment. Thorax: yellowish brown except for yellow humerus, anterior and posterior pronotum, scutellum and postnotum; acrostichal setae absent; upper anepisternum apparently bare. *Wing:* (Pl. 2); apex suffused from fR_{4+5}, dark area extending basad along M_4 a short distance; suffused at tip of R_{1+2+3}, base of R_{4+5} along anastamosis and along M_{1+2} and at bend of Cu_1 in cell M_4; suffused below apex of Sc and below humeral vein; membrane with numerous macrotrichiae in cell R_4, a few distally in cell R_3; costa barely produced beyond R_5; Sc ends in costa at level of apex of m-cu; R_{1+2+3} swollen apically, broadly joining costa basad of the apex of R_4; fold in cell R_3; M fused with Rs at bend; M_{1+2} about one half as long as anastamosis; tips of M_1 and M_2 noticeably divergent; Sc, R_{1+2+3}, R_4, R_5 setose and M_1 setose apically; M_2, M_4 and Cu_1 bare; length 4.25mm. *Haltere:* yellow. *Legs:* yellow; mid and hind coxae slightly reddened; tibial spurs subequal; apical comb on foretibia. *Abdomen:* yellowish; SVIII shaped like a papal miter. *Terminalia:* TIX subtrapezoidal, anterior margin deeply emarginate; genital arch broadly V-shaped, pigmented laterally and with a median V-shaped notch on the posterior margin; dististyle as in Plate 1.

Holotype male.—**Nepal**, Suna Chudi, 520m., 23 March 1957.

Discussion.—If the anepisternal setae are actually not present, *trispina* is the only species in the genus that I have been able to study which does not have these setae. *M. pusilla* Mg., 1830, is the only other species in the genus to have a trifid dististyle but that species has no wing pattern. This new species does not seem to be closely related to any species yet described.

6. **Macrocera simbhanjangana,** n. sp.

Represented by a series of nine males and three females from Simbhanjang which were taken along a stream in the rhododendron forest.

Male.—Head: yellowish, with vertex brown; antenna brown, about twice the body length, with first flagellar segment, scape and pedicel yellowish and eighth and ninth flagellar segments lengthened. *Thorax:* yellowish, anepisternum, katepisternum and pleurotergite suffused; mesonotum with median dark triangle with apex at level of wing base and the two lateral dark stripes from scutellum not reaching humeral angle; scutellum and postnotum suffused medianly; acrostichal setae absent; upper anepisternum with several setae. *Wing:* (Pl. 2); apex lightly suffused from about halfway in cell R_4; membrane with abundant macrotrichiae, densest apically, absent in basal area and absent or sparse basally in cells R_3, R_5, M_2, M_4, Cu_1, Cu_2 and 1st A; costa produced one-fourth length of margin of cell R_5 beyond R_5; Sc ending in costa at base of or at the level of the anastamosis; R_{1+2+3} swollen apically and meeting costa widely just basad of the apex of R_4; fold in cell R_3; M ending in bend of Rs, sometimes with a small spur ending free; M_{1+2} about twice as long as anastamosis; tips of M_1 and M_2 curving in the same direction; Sc, R_{1+2+3}, R_{4+5}, R_4, R_5, M_{1+2}, M_1, M_2, M_4, Cu, Cu_1, and 1st A setose, the setae hair-like; anal angle not excessively squared; length 5.00 to 5.25mm. *Haltere:* yellow, or yellow with brown knob. *Legs:* yellow; tibial spurs subequal; apical comb on foretibia. *Abdomen:* brown, TI with posterolateral angles light, TII and TIII with light posterior margin, TIV posterolateral angle light; SVIII shaped like a papal miter with a low peak. *Terminalia:* TIX shaped like a flattened hemisphere; genital arch broadly V-shaped; basistyle appearing subrectangular from a dorsal view; dististyle with two apical spines situated so that the interior one is almost hidden in lateral view (Pl. 1).

Female.—Similar to male. Wing length 5.00 to 6.20mm. *Abdomen:* TIV with light posterior margin, TV and TVI with posterolateral angles light.

Types.—Holotype male, *allotopotype* female: **Nepal**, Mahabharat Range, Simbhanjang 8190′, 1 Oct. 1956. *Paratopotypes:* 5♂♂ and 1♀ with same data as the holotype; 1♂ (E. I. Coher and G. P. Joshi); 2♂♂ and 1♀ (E. I. Coher and Pratap Singh).

Discussion.—The anal angle of the wing is quite rounded in this species, a condition also found in *M. trinubila* Edws., 1933, and *M. smithi* (Shaw), 1948, and approaching the shape of the wing found in *Archaemacrocera* which is probably a synonym of *Macrocera*. The shape of the basistyle, the position of the terminal spines of the dististyle and the shape of the ninth tergite separate *simbhanjangana* from all other *Macrocera* I have studied, and this species does not seem to be closely related to any yet described.

Five males and two females were taken in an unbaited Shannon trap. A single female was attracted to a light in the Shannon trap.

7. **Macrocera vishnui,** n. sp.

A single damaged male from Simbhanjang is characteristic enough to describe despite its poor condition.

Male.—Head: red brown; antenna yellow. *Thorax:* red brown; acrostichal and dorsocentral setae absent; upper anepisternum with two setae. *Wing:* (Pl. 2); badly damaged but with remaining portion showing the veins edged in brown with a hyaline membrane; suffused at fR_{4+5} and below apex of R_{1+2+3} into cell R_5; Sc ending in costa before anastamosis; R_{1+2+3} swollen apically and ending in costa about halfway between anastamosis and fR_{4+5}; Sc apically setose; R_{1+2+3}, R_{4+5} and R_5 setose; R_4 bare; estimated length 6.5mm. *Legs:* yellow; apical comb on foretibia. *Abdomen:* yellowish; SVIII shaped like a papal miter. *Terminalia:* TIX subrectangular; genital arch broadly V-shaped, deeply pigmented and with a broad, shallow emarginate median posterior margin; dististyle with a peculiar basal invagination on the median surface seen best in lateral view (Pl. 1).

Holotype male.—**Nepal**, Mahabharat Range, Simbhanjang, 8190′, 17 April 1957.

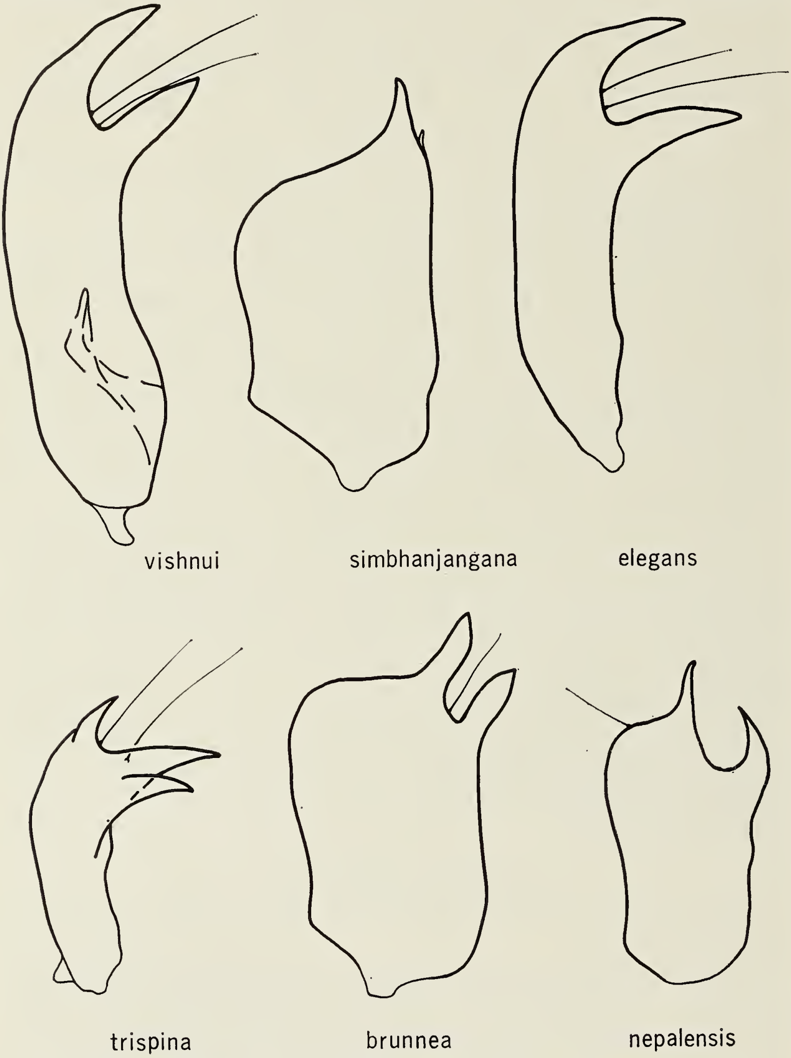
Discussion.—This species is distinctive and does not seem to be closely related to any other species in the genus known to me. The invaginated structure on the dististyle is unique in the genus as far as I can determine.

8. **Macrocera femina,** n. sp.

Represented by a single female taken from the Malay Peninsula, southern Thailand.

Female.—Head: red brown; antenna yellow, slightly longer than the body. *Thorax:* yellow brown; anepisternum brownish; katepisternum and mesepimeron with a horizontal suffused band midway; pleurotergite suffused dorsally and along posterior margin; mesonotum dark brown except for extreme humeral corner; postnotum suffused dorsolaterally; upper anepisternal and mesonotal setae not visible on mounted specimen. *Wing:* (Pl. 2); suffused

COHER PLATE I

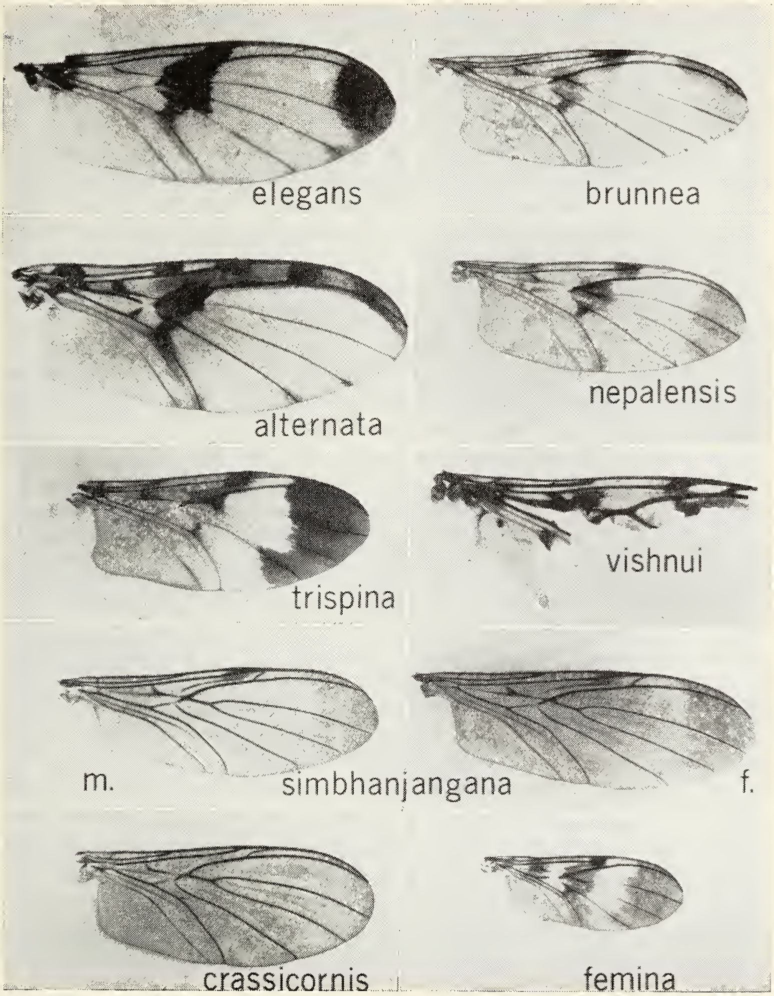


vishnui simbhanjangana elegans

trispina brunnea nepalensis

Macrocera: dististyles of males. Setae omitted.

COHER PLATE II


elegans
brunnea
alternata
nepalensis
trispina
vishnui
m.
simbhanjangana
f.
crassicornis
femina

Macrocera: wings. Male: *brunnea, nepalensis, trispina, vishnui, simbhanjangana*(m.), *crassicornis.* Female: *elegans, alternata simbhanjangana*(f.), *femina.*

except for a small light band basad of anastamosis and a larger one from R_4 barely to cell M_4; membrane without macrotrichiae; costa produced well beyond R_5; Sc ending in costa just beyond base of m-cu; R_{1+2+3} swollen apically and meeting the costa the length of R_4 before the base of R_4; fold in cell R_3; Rs weakly developed; M ending free; M_{1+2} twice as long as anastamosis; tips of M_1 and M_2 slightly divergent; M_4 obsolete at bend; Sc with a few apical setae, R_{1+2+3}, R_{4+5}, R_5 setose, R_4 and M_{1+2} bare, M_1 and M_2 sparsely setose on apical half, M_4 apically setose and Cu_1 setose distad of bend; length 3.00mm. *Legs:* yellow; tibial spurs subequal; apical comb on foretibia. *Abdomen:* shiny brown; TI to TIV with a posterior yellow margin, TV with posterolateral yellow area.

Holotype female.—**Thailand**, Trang Province, Chong, 29 June 1960.

Discussion.—Taken in an unbaited Shannon trap. This species does not seem to be closely related to any yet described, although it has a superficial resemblance to the European *M. fascipennis* Staeger, 1840.

9. **Macrocera crassicornis** Winnertz, 1863.

Winnertz, 1863, Verh. Zool.-Bot. Ges. Wien 13: 678, male.

A single male taken in Kabul, **Afghanistan**, 27 Oct. 1958 (P. F. Beales). The folding between the veins, which shows slightly in other species, appears almost vein-like in this species, particularly in photographs (Pl. 2). The banded appearance of the antennae is due to narrow light-colored bands apically and basally on the segments involved.

ACKNOWLEDGMENT

I would like to thank Dr. Frank R. Shaw for the loan of a slide of the type of *Fenderomyia smithi;* Dr. C. P. Alexander for the loan of a slide of the wing of the type of *Macrocera ephemeraeformis;* Dr. Thomas H. Farr for his guidance to the colony of fungus-gnats at the Windsor Cave, Jamaica; Dr. Paul J. Spangler for information and material of a new species of *Macrocera* from the Mary Lawson Cave, Ira, Missouri; Dr. John F. Hanson for his help and valuable suggestions in the preparation of this paper. In addition, I am indebted to the many fine assistants who worked with me in Nepal, Thailand, and Afghanistan, and the many unknown passersby who so kindly assisted in erecting traps and shelters. Finally, I would like to thank Mrs. Ruth I. Sones for typing the manuscript.

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BULLETIN

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A KEY TO THE NEW WORLD GENERA OF IASSINAE WITH REVIEWS OF *SCAROIDANA* AND *PACHYOPSIS* (HOMOPTERA: CICADELLIDAE)

By James P. Kramer[1]

The New World genera of the leafhopper subfamily Iassinae have never been keyed. Oman (1949: 43) treated two tribes, Iassini and Gyponini, which he considered as forming the subfamily in the United States. He included, in passing, the Neotropical Krisnini which have since been transferred to the Deltocephalinae by Linnavuori (1959: 151). Other and more recent workers than Oman have treated the two remaining tribes as distinct subfamilies, the Iassinae and the Gyponinae. It is with this more recent treatment that I agree.

Definition of New World Iassinae. Medium-sized to large leafhoppers (4–13.5 mm.), always robust and stout, frequently somewhat depressed. Face usually short, convex, often tumid, and with lateral frontal sutures terminating at or slightly above antennal pits. Ocelli often small, remote from eyes, and located on extreme anterior margin of crown or on extreme upper portion of face. Area between crown and face not sharply separated, always rounded, never foliaceous. Antennae normal. Crown almost always of uniform width, never sharply produced. Surface of crown and pronotum transversely rugulose. Scutellum always large and well developed. Forewings well-developed, venation often obscure, and with numerous fine setae present (except *Scaroidana*). Color yellowish to brown, rarely, if at all, with striking pattern. Male genitalia normal to highly modified.

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[1] Entomology Research Division, Agricultural Research Service, U. S. Department of Agriculture, Washington 25, D. C.

KEY TO THE NEW WORLD GENERA OF IASSINAE

1. Texture of inner apical cell of forewing distinctly membranous and sharply differing from rest of forewing 2
   Texture of inner apical cell of forewing the same as the rest of forewing 3
2. Vein separating appendix of forewing from first apical cell evanescent distally, never extending beyond base of second apical cell (Nearctic & Neotropical .... *Stragania* Stål
   Vein separating appendix of forewing from first apical cell not evanescent distally, extending beyond base of second apical cell (Neotropical) .... *Batrachomorphus* Lewis
3. Forewings without fine setae; length, males 10 mm. or more, females 11 mm. or more (Neotropical) .. *Scaroidana* Osborn
   Forewings with fine setae; length, males 7 mm. or less, females 9.5 mm. or less 4
4. Setae-bearing punctures of forewings not darkly pigmented; male genital capsule normal (Fig. 19); mesal lobe of style long, blunt apically with a short hook (Fig. 20) (Neotropical and Nearctic) .... *Pachyopsis* Uhler
   Setae-bearing punctures of forewings darkly pigmented; male genital capsule retracted into eighth abdominal segment (Fig. 21); mesal lobe of style not as above (Neotropical) 5
5. Setae-bearing punctures sparse and irregularly distributed over forewing; crown, pronotum, and scutellum without dots; pronotum in lateral view normal (Peru and Bolivia) .... *Grunchia,* n. g.
   Setae-bearing punctures numerous and uniformly distributed over forewing; crown, pronotum, and scutellum heavily marked with dark brown to black dots; pronotum in lateral view strongly swollen (Mexico) ...... *Gargaropsis* Fowler

Stragania Stål

Stragania is the largest and probably the best known genus of the New World Iassinae. Beamer and Lawson (1945) revised the Nearctic members and recognized twenty-two species. Linnavuori (1956: 16–21) published a key to the Neotropical members and included twelve species. The Neotropical fauna is undoubtedly much richer than this. Linnavuori (1957: 144–145) reduced *Stragania* to subgeneric rank under *Batrachomorphus.* However, the two genera are easily separated consistently by the character used in the key above.

The species are short and stout, mostly between 3–5 mm., rarely over 6.25 mm. The forewings are heavily setose. The ground color ranges from yellow or green to brown or reddish with or without contrasting shades. The contrasting shades may be any of the colors already mentioned or black. *Stragania* can be distinguished from all other New World Iassinae by noting that the vein which separates the appendix of the forewing from the first apical cell is evanescent distally.

Batrachomorphus Lewis

As far as known, the new species described below appears to be the first example of *Batrachomorphus* in the Americas. I am not familiar with the Old World species but am following Linnavuori's definition of *Batrachomorphus* (Linnavuori 1957: 144).

Batrachomorphus sialos, n. sp.

Length.—Male 7 mm. Female 8–8.25 mm.

Coloration.—Venter including legs and face stramineous to pale brown, all tibiae with minute black dots. Dorsum including forewings brown, ocelli reddish, crown and pronotum densely marked with minute black dots which may be variably fused, forewings at times with a vague dark-reddish or dark-greenish cast, setae-bearing punctures darker. Males darker than females.

Structure.—General form very stout, broad, and somewhat depressed. Face short and wide with clypellus small and depressed, antennal pits deep, with their bases covered by sharp, overhanging transverse ledges (Fig. 23). Crown in lateral view very blunt, rather tumid and turned down over face. Crown in dorsal view of uniform width and as wide as pronotum. Scutellum large, surface weakly transversely rugulose, and with anterior angles lightly setose. Forewings setose, thick, opaque, and with punctures distinct. Spinulation of hind femur 2–1–1.

Male Genitalia.—Male genital capsule retracted into eighth abdominal segment. Plates absent. Connective membranous and amorphous. In lateral view pygofer with a strong dorsal indentation, a few dorsal setae, aedeagus simple and somewhat V-shaped, styles reduced (Fig. 24). In ventral view aedeagus with a deep apical notch and styles slender (Fig. 25).

Female Genitalia.—Pregenital sternum with posterior margin broadly and shallowly indented.

Types.—*Holotype* male (USNM Type Number 34877) San Pedro de Montes de Oca, Costa Rica, 19 Aug. 1935, C. H. Ballou, collected on avocado. *Allotype* female and two *paratypes,* one male and one female, with same data. Five additional paratype females with same data except different collecting dates as follows: three, 24 June 1935; and two, 23 March 1936.

Discussion.—This new species conforms reasonably well to Linnavuori's refined definition of *Batrachomorphus* (Linnavuori 1957: 144). It differs in spinulation of the hind femur, 2–1–1 versus 2–2–1, and in the male genitalia having the styles reduced and plates entirely absent. These differences are not considered great enough to warrant generic separation, at least at this time.

Scaroidana Osborn

Scaroidana contains the largest species found within the subfamily. Because of the strong resemblance to *Gypona* and allied genera, *Scaroidana* was initially placed in the Gyponinae by Osborn (1938: 49). This placement was used by Metcalf (1962: 55) in his recent catalogue of the Gyponidae (= Gyponinae). However, the following combination of characters clearly indicates relationship to the Iassinae: The ocelli are located on or just below the anterior margin of the crown and are not visible in a dorsal aspect of the head, the crown is narrow and of nearly uniform width, and the general form is not depressed.

Generic Description.—Form large and robust. Male with clypellus enlarged and tumid (Fig. 2), female with clypellus normal (Fig. 1). In both sexes the surface of clypeus with dense scaly microsculpturing and upper portion of face transversely rugulose. Pronotum large with lateral margins unusually long. Forewings without setae but roughened, often with shallow inconspicuous punctures especially in claval area. Color yellow to pale brown. Male genitalia with capsule normal, pygofer and plates with macrosetae, setae of plates approximately uniseriate, hair-like setae often present on plates, pygofer with paired internal ventral processes, connective modified Y-shaped, and aedeagus simple. Type-species, *Scaroidana flavida* Osborn.

KEY TO SPECIES OF SCAROIDANA

1. Color yellow to stramineous; apex of aedeagus in lateral view as high or higher than basal portion (Fig. 5), pygofer process slender (Fig. 3) .... *flavida* Osborn
   Color pale brown to yellowish brown; apex of aedeagus in lateral view lower than basal portion (Fig. 7), pygofer process stouter (Fig. 8) 2
2. Apical cells at least partially darker than rest of forewing;

aedeagal shaft in lateral view distinctly narrowed (Fig. 9) (South America) .... *fulvula* Osborn

Apical cells not darker than rest of forewing; aedeagal shaft in lateral view not narrowed (Fig. 7) (Panama) *xouthe*, n. sp.

Scaroidana flavida Osborn

Scaroidana flavida Osborn, 1938: 50.
Pachyopsis clypeatus Linnavuori, 1957: 149, *New Synonymy.*

Length.—Male 11–11.5 mm. Female 13–13.5 mm.

Coloration.—Yellow to stramineous without darker markings. Compound eyes usually reddish.

Male Genitalia.—Pygofer process slender and recurved apically (Fig. 3). Style with mesal lobe long, slender, finely serrated on inner margin, and terminating in a sharp point (Fig. 4). Aedeagus stoutest distally with gonopore apparently located ventrally at apex (Fig. 5).

Female Genitalia.—Pregenital sternum with posterior margin truncated or very slightly produced at middle (Osborn, 1938: Pl. I, Fig. 4A).

New Records.—2 ♂♂ 3♀♀, Chapada, Brazil, Oct. and Nov. (no year) (C. F. Baker); 1 ♀, San Bernardino, Paraguay (K. Fiebrig). All are in the collection of the U. S. National Museum.

Discussion.—The South American countries from which *S. flavida* is now known number four; these are Bolivia, Argentina, Brazil, and Paraguay. The species is interpreted here on the basis of the allotype male and one paratype female kindly made available for study by Dr. D. M. DeLong.

Scaroidana fulvula Osborn

Scaroidana fulvula Osborn, 1938: 51.
Pachyopsis chulumanensis Linnavuori, 1957: 148, *New Synonymy.*

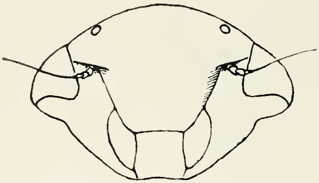
Length.—Male 10–11 mm. Female 12–12.5 mm.

Coloration.—Pale brown to yellowish brown with apical cells of forewings at least in part darker. Compound eyes reddish.

Male Genitalia.—Pygofer process slender but broadest preapically (Fig. 8). Style like that of *flavida* except extreme apex turned slightly inward. Aedeagus narrowed on distal portion with gonopore located ventrally (Fig. 9).

Female Genitalia.—Pregenital sternum with posterior margin broadly but slightly produced (Osborn, 1938: Pl. I, Fig. 5A).

KRAMER PLATE I



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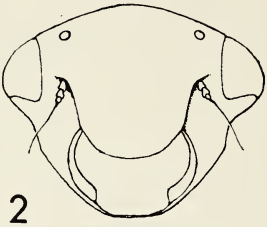

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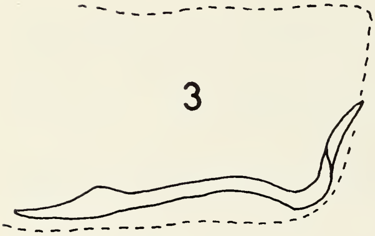

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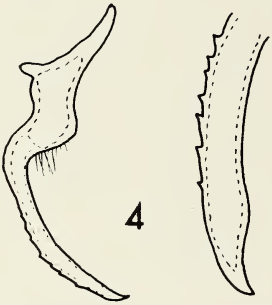

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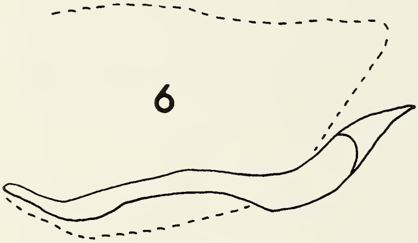

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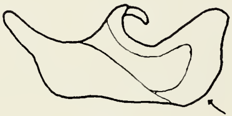
xouthe



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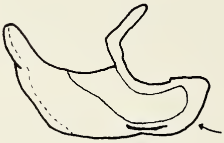

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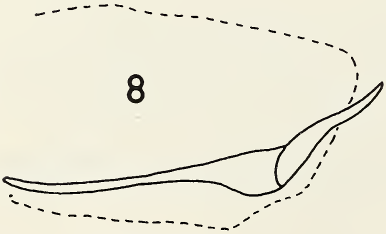

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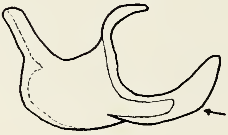
fulvula



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New Records: 1 ♂, Huacapistana, Rio Tarma, Peru, 2 June 1930; 1 ♂, Tingo Maria, Peru, Oct., 1949 (H. A. Allard); 1 ♀, Para, Brazil. All are in the collection of the U. S. National Museum.

Discussion.—*S. fulvula* is now known from Brazil, Bolivia, and Peru. The species is interpreted here on the basis of the holotype female and allotype male available for study by Dr. D. M. DeLong.

Scaroidana xouthe, n. sp.

Length.—Male 10 mm.

Coloration.—Pale yellowish brown without darker markings. Compound eyes reddish.

Male Genitalia.—Pygofer process similar to that of *flavida* but much stouter (Fig. 6). Style like that of *flavida* except inner margin not finely serrated. Aedeagus uniformly stout with gonopore located ventrally (Fig. 7).

Female Genitalia.—Female unknown.

Type: Holotype male (USNM Type Number 34878) Trinidad Rio, Panama, 17 March 1912, (A. Busck).

Discussion.—*S. xouthe* appears closest to *fulvula* on the basis of color, but the genital structures more closely resemble those of *flavida.* This new Central American species greatly extends the known distribution of the genus.

Pachyopsis Uhler

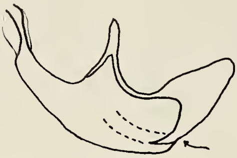
Pachyopsis has long been known from but one Nearctic species, *laetus* Uhler. Three new species from America south of the United States are described below.

Generic Description.—Form robust. Face convex, especially so in males, surface of clypeus finely rugulose. Pronotum large, with lateral margins short. Scutellum often lightly setose. Forewings

EXPLANATION OF PLATE I

Scaroidana flavida Osborn: Fig. 1, Face of female; Fig. 2, Face of male; Fig. 3, Lateral view of ventral pygofer process; Fig. 4, Ventral view of style and enlarged stylar apex; Fig. 5, Lateral view of aedeagus. *S. xouthe,* n. sp.: Fig. 6, Lateral view of ventral pygofer process; Fig. 7, Lateral view of aedeagus. *S. fulvula* Osborn: Fig. 8, Lateral view of ventral pygofer process; Fig. 9, Lateral view of aedeagus. Note: Arrows in Figs. 5, 7, and 9 indicate approximate position of gonopore.

KRAMER PLATE II



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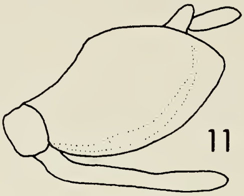

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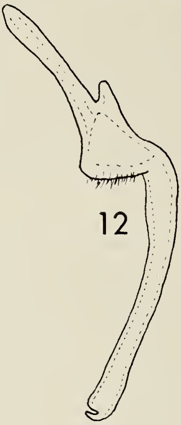
foratus



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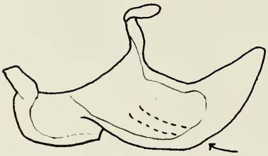

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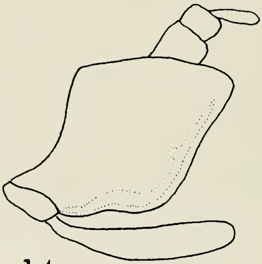
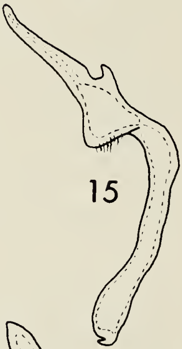


14 calceus



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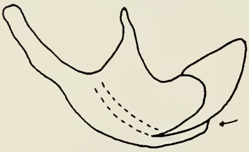

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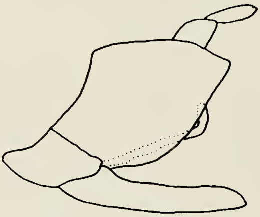
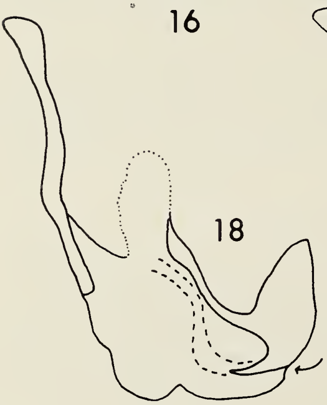


17 similis



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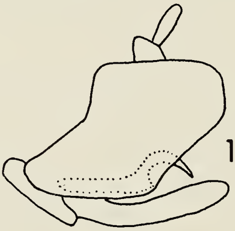
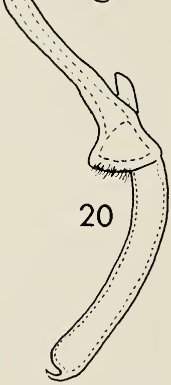


19

laetus



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with numerous fine pale setae and at times with extra veinlets in apical portions, setae-bearing punctures not pigmented. Color pale green to brown, rarely pinkish. Male genitalia with capsule normal, pygofer and plates usually with a few macrosetae and hair-like setae, pygofer with paired internal ventral processes, connective strap-like and broadened between styles, mesal lobe of style, long with a short terminal hook (Fig. 20), and with aedeagus stout.

KEY TO MALES OF PACHYOPSIS

1. Pygofer process hooked and decurved (Fig. 19); aedeagus with a distinct ventral hump (Fig. 18) (western United States) .... *laetus* Uhler
   Pygofer process not hooked and decurved; aedeagus without a distinct ventral hump (Mexico & Neotropical) 2
2. Aedeagus in lateral view with a distinct "heel" (Fig. 13); pygofer process with a proximal blunt tooth-like expansion on recurved portion (Fig. 14) (Ecuador) .... *calceus,* n. sp.
   Aedeagus in lateral view without a "heel"; pygofer process without an expansion of any sort 3
3. Pygofer process with a right-angle bend in lateral view (Fig. 17); style broadened preapically (Fig. 15); upper portion of face and crown yellowish (Brazil) .... *similis,* n. sp.
   Pygofer process smoothly upturned in lateral view (Fig. 11); style not broadened preapically; upper portion of face and crown fuscous (Mexico) .... *foratus,* n. sp.

Pachyopsis laetus Uhler

This species was completely redescribed by Oman (1949: 52); he provided excellent illustrations of the crown, thorax, and forewing. He also included synonymy and distributional data, and discussed the male genital structures but did not illustrate them. The distinctive features of the genitalia have already been noted

EXPLANATION OF PLATE II

Pachyopsis foratus, n. sp.: Fig. 10, Lateral view of aedeagus; Fig. 11, Lateral view of male genital capsule. *P. calceus,* n. sp.: Fig. 12, Broad view of style; Fig. 13, Lateral view of aedeagus; Fig. 14, Lateral view of male genital capsule. *P. similis,* n. sp.: Fig. 15, Broad view of style; Fig. 16, Lateral view of aedeagus; Fig. 17, Lateral view of male genital capsule. *P. laetus* Uhler: Fig. 18, Lateral view of aedeagus and connective; Fig. 19, Lateral view of male genital capsule; Fig. 20, Broad view of style. Note: Arrows in Figs. 10, 13, 16, and 18 indicate approximate position of gonopore.

in the key to males or in the generic description. The ventral hump of the aedeagus is somewhat variable in shape but the form illustrated seems most typical.

Pachyopsis calceus, n. sp.

Length.—Male 6.75 mm.

Coloration.—Sordid stramineous without distinct darker markings; ocelli reddish.

Structure.—A few extra veinlets near apex of forewing.

Male Genitalia.—Pygofer with internal process recurved, a blunt proximal toothlike expansion on distal portion (Fig. 14). Aedeagus slipper-shaped with a distinct "heel" (Fig. 13). Style typical of genus (Fig. 12).

Female Genitalia.—Female unknown.

Type.—*Holotype* male (USNM Type Number 34879) Paute, Ecuador, 11 August 1955 (H. R. Yust), collected on walnut.

Discussion.—I have before me three females from Banos, Ecuador, collected in 1937 by W. Clarke-Macintyre. All have the posterior margin of the pregenital sternum indented mesally and rounded laterally, but they appear too large (9–9.5 mm.) to be properly associated with the male.

Pachyopsis similis, n. sp.

Length.—Male 5.5–6 mm. Female 6–6.5 mm.

Coloration.—Yellowish-brown to pale brown with forewings often somewhat darker than head and thorax; ocelli reddish.

Male Genitalia.—Pygofer with internal process sharply upturned distally forming a right angle (Fig. 17). Aedeagus stout, prolonged basally (Fig. 16). Style with mesal lobe slightly expanded preapically (Fig. 15).

Female Genitalia.—Posterior margin of pregenital sternum very slightly produced with an ill-defined mesal notch.

Types.—*Holotype* male (USNM Type Number 34880), Jussaral, Angra-E. Do Rio, Brazil, 9 November 1934 (Travassos and Lopes). *Allotype* female and five *paratypes,* four males and one female, with same data.

Discussion.—*P. similis* and *foratus* are very close but can be separated readily on the basis of the internal pygofer process and coloration as indicated in the key.

Pachyopsis foratus, n. sp.

Length.—Male 5.75 mm.

Coloration.—Venter including legs and lower portion of face pale stramineous; upper portion of face and crown dark fuscous; ocelli pale; pronotum, scutellum, and forewings brown, forewings of a lighter shade.

Male Genitalia.—Pygofer with internal process gradually recurved and slightly narrowed distally (Fig. 11). Aedeagus stout, prolonged basally (Fig. 10). Style like that of *laetus* (Fig. 20).

Female Genitalia.—Female unknown.

Type.—*Holotype* male (USNM Type Number 34881), Cuernavaca-Acapulco Road, Mexico, 24 August 1936 (Ball and Stone).

Discussion.—This species is distinct on the basis of color and male genital characters. The aedeagus, however, is very much like that of *similis*.

Grunchia, gen. rov.

Type-species, *Batrachomorphus* (*Stragania*) *grossus* Linnavuori.

Generic Description.—Form moderately large and robust, similar to *Pachyopsis* but stouter. Clypeus and clypellus tumid, face finely transversely rugulose. Head distinctly narrower than pronotum. Lateral pronotal margins of moderate length. Forewings unusually shiny, transparent, and glassy; setae-bearing punctures rather sparse, darkly pigmented, and scattered; venation obscure except at extreme apex. Male genitalia with capsule retracted into eighth abdominal segment, anal tube and aedeagus simple, and with pseudostyles present.

Grunchia grossa (Linnavuori), new combination

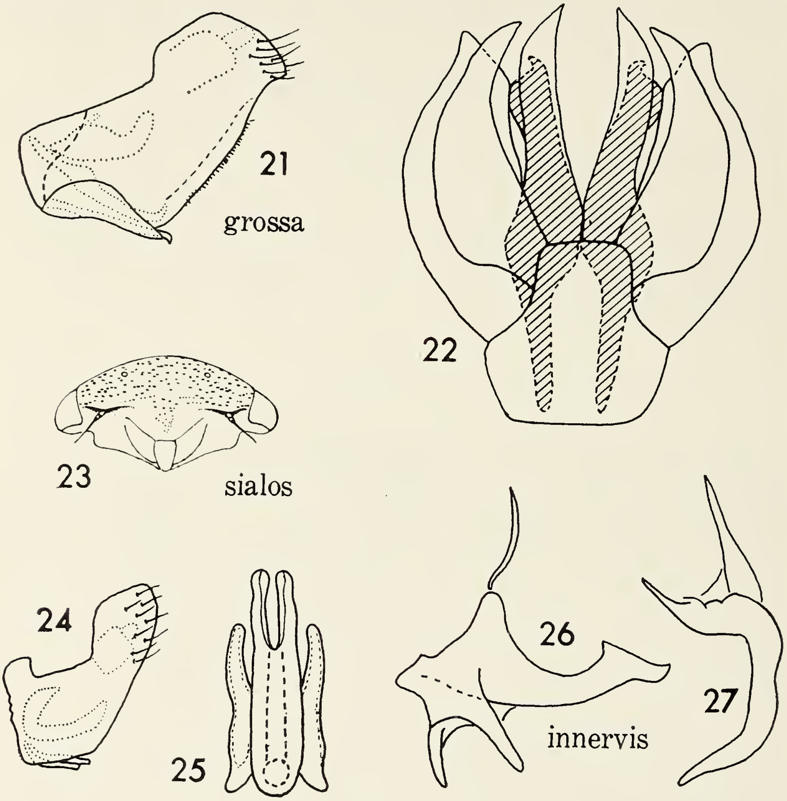
Batrachomorphus (*Stragania*) *grossus* Linnavuori, 1957: 148.

Length.—Male 6.5 mm. Female 7–7.5 mm.

Coloration.—Ground color light yellowish-brown to sordid yellowish-green. Male with irregular fuscous patches on thoracic venter and on face under antennal bases; clypellus and clypeus, except for a pale area centrally at top, darkly fuscous. Female without such markings. In both sexes ocelli pale; crown, pronotum, and scutellum without definite markings; forewings pale yellowish to golden yellowish with veins mainly concolorous except brownish apically, setae-bearing punctures brown.

Male Genitalia.—Genital capsule in lateral view with anal tube simple, pygofer with a few dorsal setae distally and a row of fine short stout setae along ventral margin, aedeagus stoutest basally and upturned distally, style elongated and upturned distally, and pseudostyle exceeding plate with apex downturned (Fig. 21). Connective membranous and amorphous. Genital capsule in ven-

KRAMER PLATE III



Grunchia grossa (Linnavuori): Fig. 21, Lateral view of male genital capsule; Fig. 22, Ventral view of male genital capsule. *Batrachomorphus sialos*, n. sp.: Fig. 23, Face of female; Fig. 24, Lateral view of male genital capsule; Fig. 25, Ventral view of aedeagus and styles. *Gargaropsis innervis* Fowler: Fig. 26, Lateral view of aedeagus; Fig. 27, Broad view of style.

tral view with styles hooked apically (shaded in drawing), pseudostyles slender between rather crescent-shaped plates, and with both pygofer and valve well-developed (Fig. 22).

Female Genitalia.—Pregenital sternum with posterior margin truncated.

Records.—This species was described from three female specimens as follows: Holotype, Callanga, Peru, and two paratypes, Chulumani, Sur-Yungas, Bolivia. All are in European collections. The male is known from a unique Peruvian specimen in the collection of the U. S. National Museum.

Discussion.—*Grunchia grossa* (Linnavuori) is readily distinguished by the unusually shiny, transparent, and glassy forewings and the unique features of the male genitalia.

Gargaropsis Fowler

Gargaropsis (Fowler, 1896: 167) was initially described as a genus of the family Membracidae. Although recognized as a cicadellid of the subfamily Iassinae by various authors, *Gargaropsis* has always been listed as a synonym of *Iassus, Bythoscopus,* or *Stragania.* In my opinion it is a distinct and valid genus.

The originally included and only species is *innervis* (Fowler, 1896: 167–168) from Xucumanatlan, Guerrero, Mexico. Unfortunately, the only known specimen is the unique type which has been illustrated in color (Fowler, 1896: Tab. 10, Fig. 15). Dr. W. E. China of the British Museum (Natural History) very kindly re-examined the type and made observation and sketches which allowed me to re-evaluate *Gargaropsis.*

Generic Diagnosis.—Similar to *Grunchia* but shorter and broader. Upper portion of face tumid. Head narrower than pronotum and appearing small due to greatly swollen pronotum. Forewings vitreous with numerous darkly pigmented setae-bearing punctures; venation moderately distinct. Male genitalia with capsule retracted into eighth abdominal segment; anal tube simple; connective straplike; aedeagus simple with apex somewhat elaborated and dorsal apodeme forked (Fig. 26, drawing inverted), style slender without an apical hook on mesal lobe (Fig. 27).

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NOTES ON THE EXTANT TYPES OF DR. O. DUDA'S COSTA RICAN DROSOPHILIDAE (DIPTERA)

By Marshall R. Wheeler[1]

Abstract: *The extant type specimens (39) of the Drosophilidae named by Dr. Duda from Costa Rica were borrowed for study from the National Museum in Budapest, Hungary. They represented 26 species of the 56 named by Duda, the remaining types having been lost. Notes on the morphology and distribution of these species are presented, lectotypes are chosen when required, and the following nomenclatural and systematic changes are made:* Cladochaeta infumata *(Duda), New Combination (from* Diathoneura*);* Diathoneura nigrifrons *Duda, New Status (described as a "variety" of* nigrescens*);* Paramycodrosophila poeciloptera *Duda, 1925* = Drosophila schildi *Malloch, 1924, New Synonymy;* Paraliodrosophila mihalyii *Wheeler, New Species (Costa Rica, Panama);* Bunostoma brasiliensis *Frota-Pessoa, 1946* = Noetanygastrella tricoloripes *Duda, 1925, New Synonymy.*

One of the major contributions to our knowledge of the Neotropical Drosophilidae was that of Dr. Oswald Duda (1925) on the species of Costa Rica. His study was based on the specimens in the Hungarian National Museum in Budapest, all apparently collected in 1921 at Suiza de Turrialba. In this paper Duda described 56 new species (including some as "varieties") and all of the types seem to have been retained in the museum in Budapest.

In the hope of settling some confusing taxonomic problems uncovered while working with the extensive Neotropical material in the University of Texas collection,[2] I contacted Dr. F. Mihályi of the Zoological Department of the museum. With his cooperation, for which I am extremely grateful, I was able to borrow for study 39 type specimens representing 26 of Duda's Costa Rican species. The holotype of one species, *Diathoneura taeniatipennis*, was inadvertently left out of the shipment; specimens of the remaining 29 species were no longer available. Dr. Mihályi has written me concerning them as follows (paraphrased in part for grammatical reasons):

"There is Drosophilid material of Duda's from Costa Rica,

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[1] Department of Zoology, The University of Texas, Austin, Texas.

[2] Field collections were made possible by grant G-4999 from the National Science Foundation.

Africa, Far East, Australia and Europe. Unfortunately this material has been damaged by water and partly destroyed. Therefore nearly half of the Costa Rican types are missing. All types of the following genera are missing: *Pseudocacoxenus, Stegana, Oxyphortica, Protostegana, Neorhinoleucophenga* and *Zygothrica.* Also missing are: *Drosophila nasalis, D. nigrohalterata, D. glabrifrons, D. fuscohalterata, D. flavohalterata, D. semialba, D. fundomaculata, D. prorepleta, D. limbiventris, D. medioobscurata, D. fumipennis, D. subinfumata, D. kerteszina, D. mediostriata, Paramycodrosophila costaricana, Tanyglossa tenuirostris,* and *Diathoneura quadrivittata.*

"I am sending you the remaining 39 types; some do not bear the same name exactly as the one they were described by; for example, four names ending with ". . . *lineata*" are labelled as ". . . *striata.*" Duda very rarely labelled the specimens as "type," but as he gave the number and date of the types, they are unquestionably the same. If they were described from a single specimen, I have labelled it as Holotype; if there are more of them, as Syntypes. Duda used to write on the first specimen of his new species both the generic and the species name, but on the following specimens only the species name. I think that it is desirable to choose and label these 'first' specimens as lectotypes. As nearly as possible, therefore, I am sending you the first specimen, which I would like for you to denominate as lectotypes and publish this information."

Lectotypes are here being designated for 16 of Duda's species, each being represented by two or more syntypes; red lectotype labels bearing my name have been attached to the pins bearing the specimens and have been returned to the museum. The remaining 10 species are represented by holotypes.

From our own collections we have been able to identify with reasonable certainty 19 of the 26 species represented by these types. For each of these any additional information on geographic distribution is given below, with occasional remarks on their morphology or classification. For the seven species still known only by their unique types, more extensive notes are presented, including some carefully drawn figures prepared by Mrs. Linda Kuich. For each species I have indicated first the number of specimens now present in the Budapest collection, as reported by Dr. Mihályi, and, in parentheses, the number and sex of those loaned for study.

1. *Drosophila abregolineata* Duda, 1925, *op. cit.*: 214. One; (Holotype ♂). Mesonotal pattern very distinctive, with the six clearly defined dark brown marks strongly contrasting with the dull tan background; the two more elongated marks are separated in

the midline by exactly one acrostichal row; posterior third of mesonotum with whitish pollinosity when seen from certain angles. The exposed part of the genitalia shows a slender pincer with a secondary branch, similar to that figured for *bocainensis* by Wheeler and Magalhaes (1962, Fig. 6, C) but the branch is located farther basally. Other characters, such as the sternopleurals, orals, etc., support the conclusion that *abregolineata* belongs in the subgenus *Sophophora,* and most probably in the *willistoni-bocainensis* complex.

2. *Drosophila alternolineata* Duda, 1925, *op. cit.:* 213. Two; (Lectotype ♀). The wings are light brown, with a moderately heavy cloud over the posterior crossvein; anterior crossvein dark and with a small cloud; apex of first costal section a little darkened. Setulae of third costal section on the basal 0.5. Additional records are: San José, **Costa Rica**; La Palma, **El Salvador**; Santa Maria de Ostuma, **Nicaragua**; Boquete, **Panama.**

3. *Drosophila angustibucca* Duda, 1925, *op. cit.:* 218. Fifteen; (Lectotype ♀, plus 1 ♀). This seems to be a widespread Neotropical species. We have only compared specimens from San José, **Costa Rica,** and Boquete, **Panama,** but this was enough to indicate that the species considered *angustibucca* in Brazil by Frota-Pessoa (1954) is probably an undescribed sibling species.

4. *Drosophila fuscolineata* Duda, 1925, *op. cit.:* 213. One; (Holotype ♂). No recurved hairs on the fore tarsi; setulae of third costal section on the basal 0.5; posterior crossvein dark but without cloud; mid-frontal hairs arranged in an obvious V-shaped pattern. In addition to Turrialba, **Costa Rica,** we have specimens from San Salvador, **El Salvador.**

5. *Drosophila gigas* Duda, 1925, *op. cit.:* 217. Five; (Lectotype ♂, plus 1 ♀). A distinctive character for this unusually large species is a rather sudden curving of the apex of the fourth vein toward the third, as in some members of the *annulimana* group. New records are: Santa Maria de Ostuma, **Nicaragua**; Volcan Santa Ana, San Salvador, **El Salvador**; Monte Vyuca, **Honduras**; Boquete, **Panama**; Chapulhuacan, Hid., **Mexico.** The specimens reported as *gigas* from Uruapan, Mexico, by Patterson and Mainland (1945) are actually *tuchaua* Pavan, judging from the individuals remaining in our collection at this time.

6. *Drosophila limbinervis* Duda, 1925, *op. cit.:* 215. Two; (Lectotype ♂, plus 1 ♀). This belongs to the *guarani* group, subgenus *Drosophila.* We have material from Monte Vyuca, **Honduras,** and from many localities in **El Salvador.**

7. *Drosophila pictiventris* Duda, 1925, *op. cit.:* 211. One; (Holotype ♀). This distinctive member of the subgenus *Hirtodrosophila* has been discussed earlier (Wheeler 1954: 54). Widespread, from **Mexico** to **Brazil.**

8. *Drosophila rostrata* Duda, 1925, *op. cit.:* 219. One; (Holotype ♂). Front dull tan; middle orbital minute; carina rather large, its surface moderately flat; face, cheeks, clypeus and palpi all tan; one prominent oral bristle; proboscis (Fig. 1) bearing a remarkable median horn-like process as described. Mesonotum and scutellum dark tan, moderately shiny; pleura and legs tan; first femur normal; fore tarsi without recurved hairs; third tarsi with two black bristles near base ventrally. Wings a bit dark, the posterior crossvein with a weak cloud, the anterior one dark but not clouded; setulae of third costal section on the basal 0.4. Abdomen appearing teneral, mostly tan with poorly defined bands. The banding pattern does not, in my opinion, agree with the description and my interpretation is shown in Figure 2. This specimen will not key correctly in Frota-Pessoa (1954) because of this pattern.

9. *Diathoneura adumbrata* Duda, 1925, *op. cit.:* 178. One; (Holotype ♂). Anterior half of wing noticeably dusky, and both crossveins with strong clouds. Mesonotum dark tan, the pleura contrastingly darker brown, this color also covering the fore coxae and the basal third of the fore femora; reminder of legs apparently pale, but the third femora may be darker near base. Halteres tan; palpi light brown; abdomen all dull brown; postvertical bristles of moderate size; anterior reclinate orbital short and thin, situated behind proclinate. Male genitalia not visible.

10. *Diathoneura albifacies* Duda, 1925, *op. cit.:* 181. Five; (Lectotype ♂, plus 1 ♀). Although the whitish face is distinctive, it also occurs in some undescribed similar Neotropical species. New records are: La Lola, Palmar, **Costa Rica**; El Recréo, Santa Maria de Ostuma, **Nicaragua**; Leticia, El Recuerdo, **Colombia.**

11. *Diathoneura cruciata* Duda, 1925, *op. cit.:* 177. One; (Holotype ♀). This species appears to belong with a group of about six undescribed Neotropical species representing (on the basis of preliminary studies of male genitalia) a new subgenus, or possibly a new genus. New records are: Volcan Boqueron, Cerro Monte Cristo, Volcan Santa Ana, **El Salvador**; Monte Vyuca, **Honduras.**

12. *Diathoneura euryopa* Duda, 1925, *op. cit.:* 179. Two: (Lectotype ♂, plus 1 ♀). The flat front with its whitish pollinose orbits is distinctive. In addition to Turrialba, we have seen material from

Higuito, **Costa Rica**; Bluefields, **Nicaragua**; Almirante, Venado Beach, **Panama**; Ft. Sherman, Mindl Dairy, Galeta Pt., **Canal Zone**; Hardware Gap, Mt. Diablo, Mavis Bank, **Jamaica.**

13. *Diathoneura guttipennis* Duda, 1925, *op. cit.*: 171. Three; (Lectotype ♀, plus 1 ♂). The particular pattern of wing spots seems to be distinctive, but there are several undescribed species with rather similar patterns. Our only new record is Changuinola, **Panama.**

14. *Cladochaeta infumata* (Duda). **New Combination.** = *Diathoneura infumata* Duda, 1925, *op. cit.*: 179. One; (Holotype ♀). The arista, with its single dorsal branch basally, is intact and not damaged as Duda suspected. The species is unique in *Cladochaeta* (known at present by the type species, *nebulosa*, and an estimated 15 undescribed Neotropical species) by having an unusually high costal index (3.7–3.9). We have four specimens from Boquete, **Panama.**

15. *Diathoneura laticeps* Duda, 1925, *op. cit.*: 175. One; (Holotype, sex uncertain). There is an undescribed similar species from El Salvador in which the posterior orbits and ocellar triangle are distinctly shiny (dull in *laticeps*) and the pleural darkening is much more widespread. In addition to Turrialba, we have seen material from La Lola, **Costa Rica**, and Cerro la Campana, Almirante, **Panama.**

16 *Diathoneura minuta* Duda, 1925, *op. cit.*: 182. Three; (Lectotype ♂, plus 1 ♀). On the lectotype the arista has four dorsal and one ventral branch in addition to the terminal fork; front tan, the triangle and orbits browner; postverticals of moderate size; proclinate and posterior reclinate orbitals rather far apart, the anterior reclinate quite minute and situated just a little behind the proclinate; palpi dark brown. Mesonotum dark tan, the scutellum darker; pleura also darkened but lacking a distinct pattern; halteres discolored; legs pale tan, the fore tarsi normal. Abdomen apparently wholly dull dark brown; the visible parts of the male genitalia are shown in Figure 3.

The female paralectotype seems to be another species. The anterior reclinate orbital is situated beside the proclinate; palpi pale tan; scutellum with the same color as the mesonotum; pleura with an ill-defined large dorsal stripe and a second stripe along the upper edge of the sternopleura; halteres tan.

17. *Diathoneura nigrescens* Duda, 1925, *op. cit.*: 184. Twenty-seven; (Lectotype ♂, plus 1 ♀). Arista with six dorsal and four ventral branches basal to the terminal fork; proclinate orbital 0.7 length posterior reclinate; middle orbital very tiny; postverticals

small; mildly polyvibrissal. Mesonotum dark tan, the pleura much blacker. Also known from Boquete, **Panama** and Santa Maria de Ostuma, **Nicaragua.**

18. *Diathoneura nigrifrons* Duda. **New Status.** = *Diathoneura nigrescens* var. *nigrifrons* Duda, 1925, *op. cit.:* 184. Three; (Lectotype ♂, plus 1 ♀). This species, along with *nigrescens,* belongs to a group of about 12 undescribed Neotropical species, all superficially quite similar but differing significantly in male genitalia. We have specimens of *nigrifrons* from Turrialba, **Costa Rica**, and Boquete, **Panama.**

19. *Diathoneura nubeculosa* Duda, 1925, *op. cit.:* 180. One; (Holotype ♂). We have three specimens from Boquete, **Panama,** which agree with the type except for a more intense color, especially on the wings. The visible parts of the male genitalia of the type agree well, however, with our material, and we suspect that the type male was teneral.

20. *Diathoneura pleurolineata* Duda, 1925, *op. cit.:* 183. Two; (Lectotype ♀). There are at least five Neotropical species similar to this one, but we have not been able to match any of them with the type. On both aristae there are two ventral branches and no signs of damage, while on our specimens there is either a single ventral branch, or there are three or four. In addition, the pleural stripe is considerably paler than on our specimens and while this could be due to a teneral condition, this does not seem to be the case. The abdomen is dull brown, with the circumanal tergite, anal plates and ovipositor distinctly paler yellow.

21. *Diathoneura tanyptera* Duda, 1925, *op. cit.:* 170. One; (Holotype ♂). The abbreviated posterior wing margin is distinctive (and very rare in the family). Anterior half of wing strongly browned, noticeably less so posteriorly; pleural stripe prominent, dark brown, but lower half of humeral callus quite pale and contrasting with the upper half which is as dark as or darker than the mesonotum. Palpi dark, paler at base, strongly protruding from the oral cavity, expanded at the tip when viewed from above. Face white; cheeks pale except for a small brown mark at vibrissal area. Legs pale; abdomen dark brown; halteres dirty-colored. The species belongs to a group of about six undescribed species all characterized by having prominently protruding black palpi.

22. *Diathoneura tesselata* Duda, 1925, *op. cit.:* 174. Four; (Lectotype ♂, plus 1 ♀). The tesselated pattern on the abdomen, consisting of distinct black blotches on a gray to grayish-yellow pollinose background, is shared by at least four undescribed Neotropical species. In addition, the ovipositor in each species is elon-

gated, essentially toothless, resembling a sword (Figure 4). The generic reference for the group is dubious, but until a more thorough study has been made, it seems premature to remove the species from *Diathoneura.* The male genitalia of the lectotype were removed, examined, and then mounted on a small bit of plastic which was attached to the pin bearing the specimen. A male from our collection, from Palmar, **Costa Rica,** agrees but other specimens, from more distant localities, have not yet been examined. On superficial resemblances, however, we seem to have material from Panama, El Salvador, Colombia, Venezuela, Puerto Rico and Jamaica.

23. *Diathoneura uniradiata* Duda, 1925, *op. cit.:* 182. Five; (Lectotype ♂, plus 1 ♀). Mesonotum moderately dark tan, the pleura darker brown but paler along the suture between sterno- and mesopleura, especially anteriorly. Abdomen dark brown, dull when viewed from most angles. Arista with six dorsal and one ventral branch basal to the terminal fork, and without signs of damage. Palpi more brown than black; postverticals of moderate size; front dull tan to light brownish. A single stout sternopleural bristle seen; legs, including fore coxae, tan. The male genitalia, moderately well exposed, are shown in Figures 5 and 6; the ovipositor of the female appeared to be somewhat retracted but its general appearance, as well as we could detemine it, is shown in Figure 7.

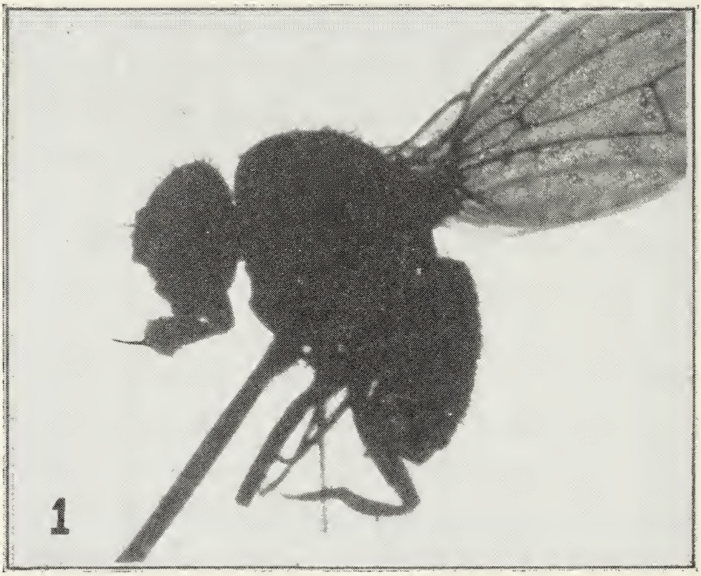
24. *Neotanygastrella tricoloripes* Duda, 1925, *op. cit.:* 224. = *Bunostoma brasiliensis* Frota-Pessoa 1946, Sum. Brasil. Biol. 1: 175. **New Synonymy.** Two; (Lectotype ♀). This is a relatively common, widespread species, known from **Costa Rica, Honduras, Panama, Colombia, Trinidad, Brazil, Peru, Puerto Rico,** and **Haiti.** The synonymy of *Bunostoma brasiliensis,* suggested as a possibility by Frota-Pessoa and Wheeler (1951) is confirmed.

25. *Paramycodrosophila poeciloptera* Duda, 1925, *op. cit.:* 226. = *Drosophila schildi* Malloch 1924, Proc. U. S. Nat. Mus. 66: 10. **New Synonymy.** Twenty-one; (Lectotype ♂, plus 1 ♀). The types of both *schildi* and *poeciloptera* have now been examined, and the synonymy, first suggested as a possibility by Burla and Pavan (1953), is confirmed. *D. schildi* is a member of the *calloptera* group of the subgenus *Drosophila,* and has now been seen from several localities in **Costa Rica, Panama, Canal Zone, Colombia, Brazil** and **Trinidad.**

Further nomenclatural problems involving the name *poeciloptera* in *Drosophila* have been discussed by Wheeler (1959: 184).

26. *Paraliodrosophila bipartita* Duda, 1925, *op. cit.:* 184. Two; (Lectotype ♂, plus 1 ♀, the latter becoming a paratype of the new

species described below). *P. bipartita* is a fungivorous species known from **Mexico, El Salvador, Costa Rica, Nicaragua** and **Panama.** In a discussion of this species I earlier stated (Wheeler 1954: 56) that the female specimen mentioned by Duda belonged to the species *dudai* which was being described by me at that time. The present study of this syntype female shows this to have been an error, this specimen belonging rather to an undescribed species represented by an additional five specimens in the University of Texas collection. I am taking this opportunity to describe this new one, which I am pleased to name for Dr. Mihályi of the Budapest museum.



Explanation of Figures

Fig. 1, *Drosophila rostrata* Duda, holotype male: Shadow photograph showing horn-like protrusion on proboscis. Fig. 2, *Drosophila rostrata* Duda, holotype male: Abdominal pattern. Fig. 3, *Diathoneura minuta* Duda, lectotype male: Sketch of the exposed portion of the male genitalia. Fig. 4, Abdomen of female of *tesselata* group showing position and appearance of ovipositor. Fig. 5 and 6, *Diathoneura uniradiata* Duda, lectotype male: Postero-ventral and lateral views of the exposed parts of the genitalia. Fig. 7, *Diathoneura uniradiata* Duda, paralectotype female: Semi-ventral view of the exposed part of the ovipositor.

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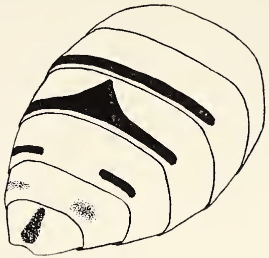

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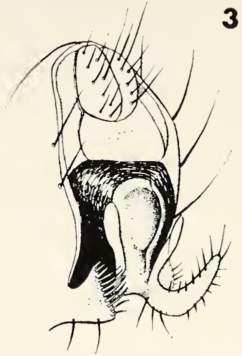

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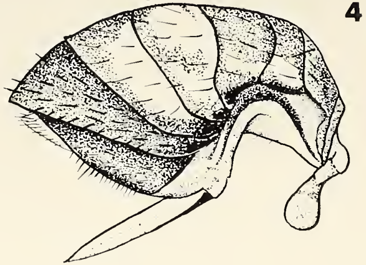

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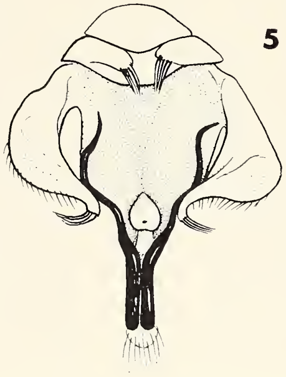

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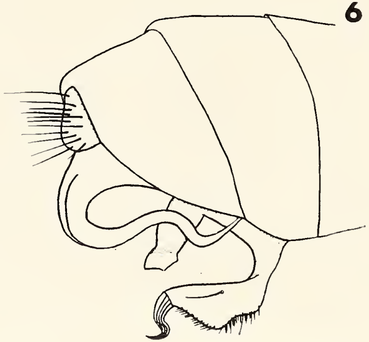

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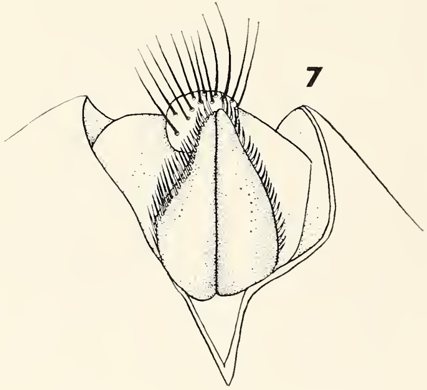

Paraliodrosophia mihalyii Wheeler, n. sp.

Male and female.—Front chestnut brown, the margins of the large subquadrate shining portion appearing darker. Antennae yellowish tan, the third segment a little darker; face, cheeks, palpi and proboscis pale yellowish; arista with five dorsal and a single ventral branch basal to the terminal fork; proclinate and posterior reclinate orbitals subequal, the middle orbital minute. Mesonotum and scutellum of the same color as the front, lightly pollinose; acrostichal hairs irregularly 4-rowed; basal scutellars weakly divergent or straight and about half length of apicals. Pleural color distinctive; lower part very pale yellow, the upper part chestnut brown; this brown area running solidly (not appearing as a stripe) from the base of the fore coxae across the meso- and pteropleura to the haltere base, but leaving a distinct pale yellow region around and below the wing base. Legs wholly pale yellow. Halteres pale. Wings hyaline; costal index about 1.4; fourth vein index about 2.2; setulae of third costal section on the basal 0.5–0.6 but not well defined.

Abdomen a little darker brown than thorax, the tergites with indistinct paramedian paler areas. Male genital arch broad above, dark and noticeably contrasting with the pale yellow anal plates and genital area. Body length about 1.5 mm.

Types.—*Holotype* male and one *paratype* male, Heredia (10 km north), **Costa Rica**, October, 1955 (W. B. Heed); one paratype male, Volcan Irazu, at 9000 feet, Costa Rica, October, 1955 (W. B. Heed); two paratype males, Boquete, **Panama**, August, 1958 (W. B. Heed and M. Wasserman); one paratype female, Turrialba, Costa Rica (syntype of *bipartita*). The latter specimen is in the Hungarian National Museum, Budapest; the remaining types are in the Drosophila Type and Reference Collection, Genetics Foundation, The University of Texas, Austin.

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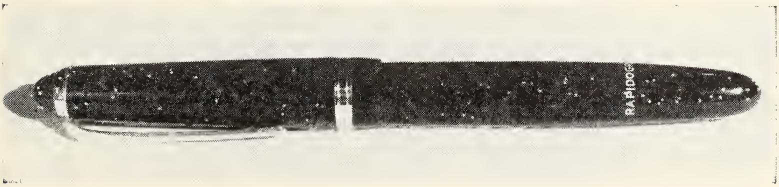
A note on abnormal oviposition habits of the cowpea weevil, *Callosobruchus maculatus.* The pen illustrated in the figure below was brought to my attention by a colleague with an inquiry concerning the numerous eggs on the cap and on the barrel. The pen was still kept in its original card-board and cellophane box, which at this time also contained a dead adult female of the cowpea weevil, *Callosobruchus maculatus* (Fab.). Approximately half the eggs had hatched, and the small larvae had eaten into the plastic pen casing to a depth of about 0.5 mm., leaving frass-filled eggshells behind them. When the pen was cleaned, it was found to be profusely pitted by their borings, though no living larvae were seen.

A semi-transparent, plastic, draftsman's triangle kept near the pen was attacked in a similar manner.—Edwin W. King, Department of Entomology and Zoology, Clemson College, South Carolina.



NEW CALIFORNIA GRASSHOPPERS OF THE GENERA *MELANOPLUS* AND *HYPSALONIA* (ORTHOPTERA, ACRIDIDAE)

By Ashley B. Gurney[1] and George M. Buxton[2]

The three species of flightless grasshoppers here described include two species of *Melanoplus* from the northwestern part of California and one species of *Hypsalonia* from El Dorado County. Discovery of the latter is somewhat surprising because it occurs in an area very close to previously known species. The genus *Hypsalonia* has recently been revised (Gurney & Eades, 1961).

The two species of *Melanoplus* comprise a new species group, discussed following the descriptions. The new group is related to the *occidentalis* group, and it not only adds to previous evidence of the rich and imperfectly known orthopteran fauna of California, but provides a further indication of the natural grouping of the numerous species of this genus. An outline of those species groups of *Melanoplus* that contain brachypterous Far Western species was given recently (Gurney, 1961, pp. 163–165), and it is anticipated that active collecting will continue to add considerably to the number of species, as well as require minor modifications of groups now recognized and the recognition of several new groups.

Paratypes will be distributed to the principal North American collections insofar as possible.

Grateful acknowledgement is made of the full cooperation, in collecting and giving other assistance, of the junior author's associates at Sacramento, Calif.; J. R. Helfer, Mendocino, Calif.; D. C. Rentz, California Academy of Sciences; and H. F. Strohecker, University of Miami, Coral Gables, Fla. The illustrations were made by Arthur D. Cushman, Entomology Research Division, U. S. Department of Agriculture.

Melanoplus keiferi, n. sp.

Figs. 1, 4–6

Holotype.—Male. Northwest corner of Glenn Co., Calif., 4.5 miles south of Mendocino Pass, 6,500 feet, 29 July 1960, in copula (H. B. Leech). [U. S. National Museum, Type No. 66, 498].

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[1] Entomology Research Division, Agricultural Research Service, U. S. Department of Agriculture, Washington 25, D. C.

[2] Bureau of Entomology, California Department of Agriculture, Sacramento 14, California.

Size medium for group; tegmina reduced in length, lanceolate. Head in dorsal view with interocular distance in proportion to width of compound eye as 4:11; fastigium strongly declivent anteriorly and shallowly sulcate; frontal costa not sulcate except slightly near median ocellus. Pronotum with lateral carinae indistinct, especially on anterior part of prozona; median carina of prozona weak, absent on posterior half, cut by two sulci; median carina of metazona distinct; entire surface of pronotum dull, with sparse but prominent short hairs, best seen in lateral view; principle sulcus feebly curved anteriorly where it cuts median carina; median carina of prozona barely longer than metazona; posterior margin of metazonal disk broadly produced, of about 120 degrees angulation; prosternal spine bluntly conical. Tegmina extending above about one-half the abdomen, overlapping for their entire length. Apical portion of abdomen moderately enlarged and weakly curved dorsally. Legs robust.

Supra-anal plate (Fig. 1) equilaterally triangulate, lateral margins somewhat elevated in basal third; 2 longitudinal submedian ridges strongly developed and at posterior ends curved 90 degrees laterally to form a transverse ridge, centrally broken. Furcula scarcely present. Cercus (Fig. 4) broadly attached, expanding slightly for one-half of length, then expanding mesally conspicuously, becoming one-third larger distally and reminiscent of the *occidentalis* group, lateroposterior extremity more angulate than in *chimariki,* surface near apex broadly and shallowly concave.

Concealed genitalia (extracted and preserved dry, attached to specimen; description largely from paratypic preparation in glycerine) with main fleshy portion of aedeagus erect (Fig. 5); a specialized, parchmentlike piece arising dorsally at each side, darkly pigmented on most of a lateroposterior lobe, anterior portion of this piece unpigmented and divided into a long lateral and a short mesal lobe; dorsal valves long, slender, tapering, gently curving posteriorly near tips, indistinctly pigmented along margins; ventral valves shorter than dorsal valves, narrow, straplike, only moderately pigmented; epiphallus with ancorae large and down-curved, lophi prominent and in lateral view with dorsal margins broadly rounded.

Coloration.—Dorsal surface of head, thorax, tegmina, front and middle legs light grayish-brown, abdomen and ventral surface of body pale clay yellow; hind femur pale, with 3 black transverse bars on lateral and dorsal surfaces, the one at extreme base indistinct, genicular area also dark, pink ventrally and on basal two-thirds of mesal surface, genicular area and transverse bar on apical third black on mesal surface; hind tibia grayish-blue, some black at base, spines black, spurs black-tipped; tarsi pale.

Measurements (in millimeters).—Length of body, 17.0; pronotum, 4.5; hind femur, 9.7; front femur, 3.5; tegmen, 5.9. Greatest width of pronotum (posterior, including lateral lobes in perspective from above), 4.0; hind femur, 3.1; front femur, 1.1; tegmen, 2.4.

Allotype.—Female, same data as holotype and collected mating with it. [U. S. National Museum].

Head in dorsal view with interocular distance in proportion to width of a compound eye as 7 : 12; eye less globose than in male; fastigium feebly sulcate, median carina of prozona slightly longer than metazona on median carina (as 21 : 20); posterior margin of pronotum with about 130 degrees angulation; tegmina reaching to middle of tergum 4, over a little less than half the length of abdomen. Cercus with dorsal margin nearly straight, ventral margin strongly convex, apex blunt, rounded; dorsal ovipositor valve with "scoop" deeply and broadly concave, basal portion with quadrate irregularities along lateral margins, transverse basal ridges also present.

Coloration.—Essentially as in holotype, but a little darker with colors less contrasting.

Measurements (in millimeters).—Length of body, 21.5; pronotum, 5.2; hind femur, 11.0; front femur, 3.2; tegmen, 7.0. Width of pronotum, 5.0; hind femur, 3.5; front femur, 0.8; tegmen 3.1.

Variation.—The holotype and allotype are slightly larger than the paratypes. Ten male and 10 female paratypes have been measured (in millimeters), with results as follows: Length of body of males 14.0–17.0 (av. 15.83), of females 19.0–22.0 (av. 20.90); of pronotum of males 3.7–4.2 (av. 4.00), of females 4.6–5.3 (av. 4.96); hind femur of males 8.7–9.5 (av. 9.00), of females 10.1–11.4 (av. 10.73). Most males which have not had the abdomen relaxed for genitalic study have marked dorsal curvature of the abdomen; average body length for 6 such males is 14.9 mm. Tegmen length is nearly uniform, and in most paratypes of both sexes the tegmina extend above a little less than half of the abdomen. Little variation in the shape of the male cercus occurs, and all the paratypes differ from the unique type of *chimariki* on the basis of the male cercus. In about half of the males there are no distinct transverse ridges at the apices of the submedian longitudinal ridges of the supra-anal plate.

The aedeagus of 12 paratypes (6 dry, 6 in glycerine) has been examined, and in most of them the small mesal lobe of the specialized lateral piece is indefinite and inconspicuous. The tall anterior lobe is always well developed and conspicuous. The pigmented area of the lateroposterior lobe is striking in all except one specimen; it sometimes rises decidedly above the level of the fleshy lobes of the main body of the aedeagus, and it usually is a diagnostic character of *keiferi.*

Except that some paratypes are somewhat darker, with light and dark colors less contrasting, there is no significant color variation among the paratypes.

Specimens examined.—56 (26 ♂, 28 ♀, 2 juv. Holotype, allotype, paratypes). California: Mendocino Pass, 26 July 1961 (J. R. Helfer), 5 ♂, 3 ♀, 2 juv.; northwest corner of Glenn Co., 4.5 miles south of Mendocino Pass, 6,500 feet, 29 July 1960, in copula (H. B. Leech) (holotype, allotype); Plaskett Meadows, 14 Sept. 1960 (G. M. Buxton), 11 ♂, 8 ♀, includes 2 mating pairs; 4 miles west of Plaskett Meadows Station, 27 Aug. 1961 (D. C. Rentz), 5 ♂, 5 ♀; 2 miles west of Plaskett Meadows Station, 27 Aug. 1961 (D. C. Rentz), 4 ♂, 11 ♀.

The place referred to on labels as "Plaskett Meadows Station" appears on some maps as the Plaskett Ranger Station. The type series originated at various places along a stretch of about 8 miles of the Alder Springs Road, extending northwest from the ranger station to Mendocino Pass. Plaskett Meadows, per se, is the name given to open, upland meadowlike areas bordering the Alder Springs Road, mainly some 4 miles northwest of the ranger station.

It is a pleasure to name this grasshopper in honor of our friend Hartford H. Keifer, who for many years has been a leading California naturalist. The vicinity of Plaskett Meadows in Glenn County is one of his favorite collecting sites.

Melanoplus chimariki, n. sp.

Figs. 2, 7–9

The only known relative of *chimariki* is *keiferi,* described above. The male cercus apparently permits separation of the two species, but the aedeagus is clearly diagnostic for each and should be consulted for precise identification. The most distinctive structure is the specialized lateral piece which arises from the aedeagus.

Holotype.—Male. South Fork Mountain, 4 miles southwest of Hyampom, Trinity Co., Calif., 14 Sept. 1960, Calif. Dept. Agric. no. 62J23-3 (T. Gallion) [U. S. National Museum, Type no. 66, 499].

Size medium for group; tegmina lanceolate, the widest area in the proximal one-third. Head in dorsal view with interocular distance in proportion to width of compound eye as 3:7; fastigium strongly declivent anteriorly and moderately sulcate; frontal costa shallowly sulcate. Pronotum with lateral carinae very broadly rounded on metazona, absent from anterior part of prozona; median carina low but distinct on metazona, absent on prozona; principal sulcus slightly curved anteriorly where it cuts the mid-line; mid-line of prozona cut by a sulcus very near anterior margin, a second one about mid-length, and a third one-fourth the length from posterior margin; prozona and metazona of subequal length on mid-line; posterior margin of metazonal disk rounded, with 120 degrees angulation; prosternal spine bluntly conical. Tegmina extending slightly beyond base of abdominal tergum 5, over about half of abdomen, overlapping for entire length; wings a little shorter than tegmina, incapable of flight.

Apical portion of abdomen weakly enlarged and moderately curved dorsally. Supra-anal plate (Fig. 2) equilaterally triangulate; lateral margins somewhat elevated in basal two-thirds; longitudinal submedian ridges moderately developed; no transverse ridges. Furcula scarcely present; cercus (Fig. 7) broadly attached as in *keiferi,* expanding lateroposteriorly in a gentle curve, not abruptly as in *keiferi,* the mesoposterior portion broadly produced, the surface of apical half conspicuously concave.

Concealed genitalia (preserved in glycerine) with fleshy portion of aedeagus erect and turretlike (Fig. 8); a specialized piece arising dorsally from mesal margin of each outer side; transparent and membranous except for narrow pigmented vertical stripe lateroposteriorly; dorsal valves slender, tapering, erect and gently curving posteriorly near apex, moderately pigmented; ventral valves short, narrow, not curved posteriorly, scarcely pigmented; epiphallus as in *keiferi.*

Coloration.—Ground color grayish-brown, region of mouth, ventral surface of thorax, and most of abdomen pale brown; compound eyes reddish-brown; hind leg about as in *keiferi,* ground color of femur a little paler, and transverse bars less distinct.

Measurements (in millimeters).—Length of body, 20.0; pronotum, 4.6; hind femur, 10.7; front femur, 3.7; tegmen, 7.2. Greatest width of pronotum, 4.3; hind femur, 3.2; front femur, 1.2; tegmen, 2.8.

Specimens examined.—1 ♂ (holotype).

The type locality of *chimariki,* on the Blake Mountain Lookout service road, is on the crest of the South Fork Mountain ridge where it crosses the line between Trinity and Humboldt Counties at an estimated elevation of 5,700 feet. This is 4 miles southwest of the village of Hyampom and about 55 air miles north and west of Plaskett Meadows where *keiferi* was discovered.

The specific name is adapted from the name of the Chimariko Indians, a very small tribe which occupied a restricted area of the Trinity River valley just north of Hyampom.

CHARACTERS OF THE KEIFERI GROUP

For the two species just described we recognize a new species group, known as the *keiferi* group. Particularly in the shape of the male cerci, closest relationship to the *occidentalis* group is suggested. The cerci also suggest relationship to the *rileyanus* group, but an analysis of several characters shows that relationship to the *rileyanus* group is apparently quite distant.

Male cerci of the *keiferi* and *occidentalis* groups are somewhat similar to each other except that those of the former have a longer base, thus acquiring a more boot-shaped appearance. On the other hand, the cerci of the *rileyanus* group curve mesally more strongly and the apical margin is more irregular. The furcula is absent to very short in the *keiferi* group, very short in the *occidentalis* group but approaches one-half the length of the supra-anal plate in the *rileyanus* group. Tegmina are reduced in length and lanceolate in the *keiferi* group, fully developed in all of the *occidentalis* group except *occidentalis brevipennis* Bruner, which has reduced lanceolate tegmina, and quite short and lobate in the *rileyanus* group.

In the *keiferi* group the dorsal and ventral valves of the aedeagus are elongate and narowly straplike, and each dorsal valve is distinct at base from the corresponding specialized lateral piece which arises from the aedeagus. In the *occidentalis* group the dorsal and ventral valves are shorter, scarcely or not at all straplike, and at the base the dorsal valve is closely joined to the specialized lateral piece. The dorsal and ventral valves of the *rileyanus* group are quite different from those of the *keiferi* group.

In distribution the *keiferi* group is restricted to northwestern California; the *occidentalis* group extends from the Great Plains westward across the Great Basin, but it occurs in California only in the extreme northeast and near the base of the eastern Sierras (Panamint Range); the *rileyanus* group is known only from Yuba and Placer Counties south to Inyo, Kern, and Los Angeles Counties, California. The most fundamental reason for placing *keiferi* and *chimariki* in a group distinct from the *occidentalis* group (*occidentalis occidentalis* (Thomas), *occidentalis brevipennis* Bruner, *cuneatus* Scudder, *rugglesi* Gurney, is the dissimilarity in the parts of the aedeagus. Each of the three groups here discussed is a very cohesive assemblage of species so far as the aedeagus is concerned.

Hypsalonia merga, n. sp.
Figs. 3, 10–12

In size, coloration and distribution, *Hypsalonia merga* is very similar to *H. rentzi* Gurney & Eades. The aedeagus, however, is very distinct, especially in the ventral valve, which is forked in *merga* and knobbed in *rentzi.* For most male specimens, the prominences of the supra-anal plate are more evenly shelflike in *merga* than in *rentzi,* but this feature does not separate all males, and dependence must be placed on the aedeagus.

Holotype.—Male. Top Lake, El Dorado Co., Calif., ex-*Carex* sp., 22 Aug. 1962, Calif. Dept. Agric. no. 62J23-1 (Buxton & Blanc) [California Department of Agriculture, Sacramento, Calif.]

General appearance fusiform; without conspicuous vestiture. Head with dorsal interocular distance about twice the width of an eye; frontal costa a little narrowed at junction with fastigium, strongly sulcate; carinae bordering fastigium at narrowest interocular area prominent; width across eyes in frontal view compared with width across genae as 30 : 34; dorsal level of eyes in frontal view slightly below highest level of vertex.

Lateral lobe of pronotum with ventral margin straight in poster-

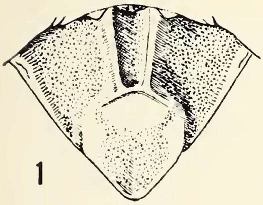
EXPLANATION OF PLATE

Melanoplus keiferi, n. sp. Fig. 1, Supra-anal plate, holotype. Fig. 4, Cercus, male paratype from Mendocino Pass. Fig. 5, Posterior view of aedeagus (in glycerine), paratype from Plaskett Meadows. Fig. 6, Lateral view of aedeagus, same paratype as in Fig. 5.

Melanoplus chimariki, n. sp. (all drawn from holotype). Fig. 2, Supra-anal plate. Fig. 7, Cercus. Fig. 8, Posterior view of aedeagus. Fig. 9, Lateral view of aedeagus.

Hypsalonia merga, n. sp. Fig. 3, Supra-anal plate, holotype. Fig. 10, Dorsoanterior view of aedeagus (dry), paratype. Fig. 11, Lateral view of aedeagus. Fig. 12, Posterior view of aedeagus. Figs. 11–12 from same paratype as Fig. 10.

GURNEY AND BUXTON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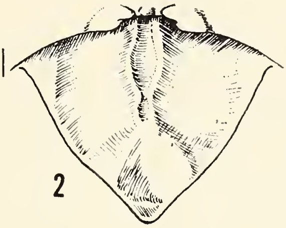
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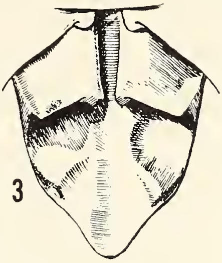
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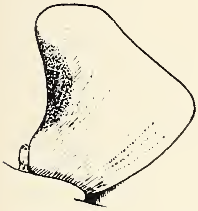
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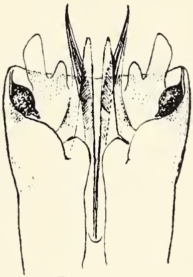
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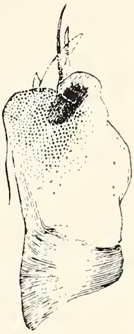
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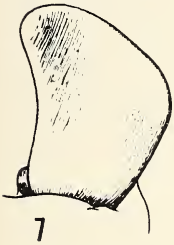
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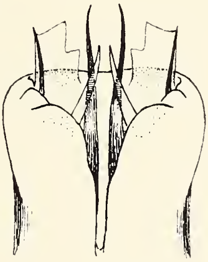
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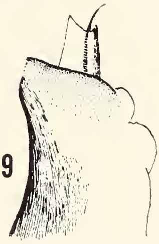
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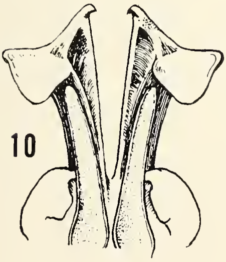
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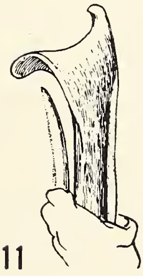
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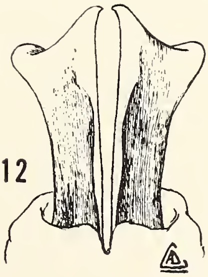
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ior portion, curved with slight concavity anteriorly; ventroposterior angle approximately 90 degrees; prosternal process extremely weak; minimum width of mesosternal interspace subequal to opposite width of a lateral lobe; distance between metasternal pits a little less than opposite width of a lateral lobe, as 11 : 14; front and middle femora each longer than pronotum.

Cercus roughly quadrate, the apical margin directed obliquely to the ventral margin from a moderately acute point at the extreme apex, near the end of the dorsal margin; furcula consisting of minute rounded lobes; prominences of supra-anal plate (Fig. 3) shelflike, the lateroposterior corners distinctly elevated but in line with posterior margin of "shelves"; paraproct with subapical carina.

Concealed genitalia (preserved in glycerine) with dorsal aedeagal valves erect, slender, blunt-tipped, shorter than ventral aedeagal valves; each ventral valve distinctively forked so that a broad shelf-like portion extends anteriorly (Figs. 10–12). Epiphallus much as drawn for *miwoki* by Gurney and Eades (1961, Figs. 17–19), but posterior margin of bridge much narrower in dorsal view.

Coloration.—Agrees well with *rentzi* as originally described, but pale areas with yellow ochre tinge more than gray; a third dark transverse bar on hind femur (at extreme base) hardly distinct, but two usual bars and that opposite darkened genicular area well developed.

Measurements (in millimeters).—Length of body, 19.0; pronotum, 3.0; hind femur, 9.5; front femur, 3.7. Greatest width of pronotum, 5.3; hind femur, 2.5; front femur, 1.2.

Allotype.—Female, same data as holotype. [U. S. National Museum].

Head with ratio of dorsal interocular distance to width of an eye as 9 : 11; frontal costa scarcely sulcate; fastigium moderately concave, the bordering carinae prominent; width across eyes in frontal view compared to width across genae as 8 : 9. Disk of pronotum scarcely cut by 2 sulci anterior to principal sulcus; minimum width of mesosternal interspace much greater than opposite width of a lateral lobe (as 5 : 3); metasternal pits much more distant than width of a metasternal lobe (surface not smooth for measuring).

Supra-anal plate with longitudinal depression anterior to distinct transverse carina, trace of longitudinal depression in posterior fourth; dorsal prominences well developed for this sex; dorsal valves of ovipositor shallowly concave, lateral margins acute. Spermatheca not examined.

Coloration.—Essentially as in holotype, but contrasting colors not conspicuous due to method of preservation.

Measurements (in millimeters).—Length of body, 22.5; pronotum, 4.6; hind femur, 10.5; front femur, 3.4. Greatest width of pronotum, 6.5; hind fermur, 2.6; front femur, 1.0.

Variation.—The 4 male paratypes show no significant structural variation. Three of them have traces of pink on the ventral surface of the thorax and near the end of the abdomen; one of the three also has the dorsum of the abdomen tinged with red. The four are of very uniform size (measurements in millimeters: Body, 18.0; pronotum, 3.0; hind femur, 9.0).

Specimens examined.—9 (5 ♂, 1 ♀, 3 juv. Holotype, allotype, paratypes). The entire series has the same data as the holotype.

Hypsalonia merga is known only from Top Lake, in northeastern El Dorado County, Calif. It is 8 miles west of Fallen Leaf Lake and about 4 miles northwest of Devils Basin, the nearest locality known for *H. rentzi.* The altitude of Top Lake is about 8,200 feet, and an escarpment rises rapidly to the north and east to a ridge of 9,300 feet; an equally rapid drop to the south and west of another thousand feet tends to isolate the lake, which occupies about 3 acres in the fall and probably twice that area in the spring. The terrain is essentially granitic, and the new grasshopper appears to be associated with sedges that grow abundantly around the lake.

The name *merga* is from a Latin word meaning "two-pronged pitchfork," in allusion to the forked apical portion of the ventral aedeagal valves.

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BIOLOGICAL NOTES ON *CERCERIS BLAKEI* CRESSON (HYMENOPTERA: SPHECIDAE)

By Karl V. Krombein[1]

Cerceris blakei Cresson is one of the smallest species of *Cerceris* in the southeastern United States, females usually ranging in length from 7.5 to 9 mm. It is also one of the most abundant species of the genus in sandy areas. I have taken it in large numbers on the barrens at Kill Devil Hills, North Carolina, and from several areas with sandy soil in Florida. Label data on specimens in the U. S. National Museum and my personal collections indicate a flight range of at least March 29 to September 17 in peninsular Florida and May 24 to September 14 in coastal North Carolina, so undoubtedly there are two or three generations a year in both areas.

The observations which follow were made during a period of residence at the Archbold Biological Station, Lake Placid, Fla., June 17 to July 5, 1962. The actual observations were made in an area of gently rolling white-sand scrub adjacent to Lake Annie, just SW of the junction of State Roads 17 and 70, about a mile north of the Station property, and on the sparsely vegetated sand flats along the Peace River at Arcadia, about 35 miles west of the Station. The Lake Annie area had a sparse to moderately thick vegetative cover with grasses, *Leptoglottis,* and other sand-scrub plants, together with scattered scrub hickory, scrubby live oak, and scrub palmetto or bluebud, *Sabal Eltonia* Swingle. This palmetto has a lengthy blooming period; some plants were in fruit, others in bloom, and still others just in the early bud stage during my visit. I mention it particularly because the flowers were very attractive to the principal prey of the *Cerceris.*

The Florida population of *blakei* has darker wings, frequently reduced yellow markings on the abdomen, and the first two abdominal segments dull red. However, there is a clinal gradation toward the coastal North Carolina population which has lighter wings, well-developed yellow markings on the abdomen, and an absence, or reduction in the amount, of red on the basal segments.

Despite its abundance, I was unable to obtain any biological data on *blakei* during a number of visits to coastal North Carolina. In the Lake Annie area, however, at 0830 hours on June 23 I saw a female (62362 A) fly into her burrow near a grass tuft in an almost level area of bare sand. She flew out in a few seconds and returned half a minute later, at which time I netted her, took her prey, and freed her. The prey was a small (2.5 mm. long), rather slender, light-tan weevil, *Derelomus basalis* LeConte, having a castaneous bill and a small median blotch anteriorly on the elytra. This is a common weevil and has much the same range as the wasp which preys on it. Several minutes later I saw a second female *blakei* (62362 B) fly into her burrow near a fallen twig in a bare sandy area only ¾ meter from the nest of A. I took a *basalis* weevil from her on her next provisioning flight. The identity of both of the wasps was determined by hand-lens examination of the characteristic clypeal process and inflated tegulae. No other individuals were found in the immediate area on June 23, nor during the following 3 days while nest A was under observation.

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[1] Entomology Research Division, Agricultural Research Service, U. S. Department of Agriculture, Washington 25, D. C.

The burrow entrances were about 3 mm. in diameter, and there was no spoil heap of excavated sand surrounding the entrances. If such a spoil heap existed, it was undoubtedly washed away by the heavy rains of the previous day or two.

I watched the provisioning flights of these two females during part of the morning and found that 11 provisioning flights of wasp A averaged 1¼ minutes (range 15 seconds to 3¼ minutes), and that she stayed in the burrow an average of 28 seconds (range 10–70 seconds) between flights. Wasp B worked a little slower or flew farther for prey, because 10 provisioning flights required an average of 2 minutes each (range 40 seconds to 3½ minutes); her periods in the burrow also averaged 28 seconds (range 10–55 seconds). So far as I could determine the wasp clutched the small weevil prey in her mandibles and flew directly and swiftly into the burrow. As is customary in *Cerceris, blakei* did not make a temporary closure when leaving the burrow. So far as I observed, *blakei* never made a temporary closure from within until she completed her hunting activities each day. When returning with prey, the wasps usually flew swiftly and directly toward the burrows, and only half a meter above the ground.

Wasp A always flew WSW when she left the burrow to hunt for prey, and B flew ESE. I was able to trace A to the source of her weevil prey, and found that she was visiting the flowers of a couple of scrub palmettos located 5–6 m. from her burrow. The *basalis* weevils were apparently visiting the flowers only, because I could find none on the buds or fruits of other palmetto plants. The weevils were quite abundant, and crawled fairly rapidly over the flower spikes, particularly on the stamens. Frequently a dozen could be seen on a single spike of bloom. The wasp flew from flower spike to spike and explored each on foot. Usually she found a weevil in only a few seconds, grasped it in her mandibles, and bent her abdomen underneath to sting it in the venter. Sometimes she would fly with the weevil to an adjacent palmetto leaf or grass blade before stinging it. At such times she clung to the leaf or grass blade with her mid and hind legs while stinging the weevil. The entire capture and stinging took only a few seconds, and then the wasp flew off straight to her burrow.

When I returned from lunch at 1330, both burrows were tightly closed from within, and I dug up that of wasp B. The sand was moist ½ cm. beneath the surface, and I found a solid plug of damp sand in the upper 9 cm. The burrow was perpendicular and 3 mm. in diameter. There was a holding cell immediately beneath the plug containing 39 paralyzed *basalis* weevils, 2.3–3.5 mm. long, interspersed among loose sand grains. The wasp flew out and escaped when I reached a depth of 15 cm. I continued the excavation to a depth of 30 cm. and the same diameter, but I found no provisioned cells. This nest probably was begun just the day before, because I watched wasp B bring in at least 17 weevils the morning of the 23rd.

On the following three days, June 24–26, I watched the nesting activities of wasp A during each morning. The nest entrance was already open when I arrived at 0755 on June 24. The air temperature in the shade was 83° F. at 0800 and had risen to 91° by noon. The wasp worked diligently and brought in 76 weevils between 0805 and 1151. Sixty-six of the provisioning flights averaged 58 seconds each, and ranged from 15 to 200 seconds. Seventy-one periods in the burrow averaged 23 seconds each and ranged from 5 to 75 seconds. All of her provisioning flights were toward the WSW, to the same palmetto plants visited the previous day, but periodically the wasp flew toward the NE and remained away for longer periods. Presumably these flights were made to obtain nectar, for I saw several female *blakei* visiting flowers of *Aldenella tenuifolia* (Torrey and Gray) Greene subsequently. When wasp A returned from these feeding (?) flights, she always flew in from WSW, so presumably she flew from her nectar source to the weevil source before returning to her nest. There were at least five feeding (?) flights on June 24, ranging from 4 to 51 minutes in duration. The longest one was made just prior to her closing the burrow from within at 1151. There were no other burrow closures during the morning, and the nest remained closed for the rest of the day.

There was an extremely heavy rain the evening of June 24, and wasp A did not open her burrow until 0928 on June 25. Her exit was impeded by several grass blades which had washed across the entrance. She flew off to the NE at 0930 (to feed ?) without making an orientation flight, and returned from SW with a weevil at 0943. Prior to her return I removed the grass blades and apparently loosened some of the sand at the entrance, because the wasp spent several minutes firming the sand around the upper part of the burrow after she deposited her first weevil in the nest. This day, wasp A worked until between 1330 to 1400, at which time the entrance was plugged from below. In the light of data obtained subsequently, it appears that wasp A worked for a long enough period each morning, approximately 4 hours, to obtain sufficient weevils to store one cell and then closed the burrow for the day. Fifty-six timed provisioning flights this morning ranged from 15 seconds to 2 minutes and averaged 52 seconds each. Sixty-three periods in the next averaged 21 seconds each, and ranged from 10 to 85 seconds. Again, the wasp made at least five flights to feed (?) ranging from 6½ to 14 minutes. Again this day she continued to exploit for prey the palmetto blooms 5–6 m. WSW of her nest.

There was no rain the evening of June 25, and wasp A was already bringing in weevils when I reached the nesting site at 0808 on June 26. For the next 10 minutes she continued flying WSW to obtain weevils, but then she started to fly S for prey. When I examined the palmetto she had been visiting earlier, I found that the blooming period was finished and that no weevils remained on the plant. The nearest blooming palmetto was now 18 m. S of the nest, and there were plenty of weevils on it. Thirty-four provisioning flights averaged 77 seconds each, and ranged from ½ to 4 minutes. Thirty-seven periods in the burrow averaged 23 seconds, and ranged from 10 to 80 seconds. I did not watch the wasp for the entire morning. However, it closed its burrow from within between 1130 and 1255.

This wasp (62362 A) was a very efficient huntress. Several periods of sustained provisioning uninterrupted by feeding (?) flights were clocked as follows on the indicated dates:

June 24 — 0824 to 0845 — 21 weevils in 21 minutes
0852 to 0908 — 15 weevils in 16 minutes
0935 to 1018 — 22 weevils in 43 minutes
June 25 — 0947 to 1013 — 23 weevils in 26 minutes
1023 to 1030 — 7 weevils in 7 minutes
1054 to 1110 — 13 weevils in 16 minutes
June 26 — 0824 to 0910 — 30 weevils in 46 minutes

The longest sustained period of hunting was the 46-minute span during which the wasp brought in 30 weevils.

I did not observe nesting activities at nest 62362 A on June 27, but I did note that the burrow entrance was open at 0820, 1250, and 1430.

At 1050 on June 27 I noted another female *blakei* (62762 B) fly into her nest 20 cm. E of 62362 A. I captured the wasp when she left the burrow, confirmed her identity, and released her. The nest was on a slight slope of bare sand, the burrow diameter at the entrance was 6 mm., and there was a low mound of excavated sand at the entrance. The entrance was still open at 1315, when I began to dig up the nest. I captured the female when she returned to the burrow 20 minutes later. There was a holding cell containing 45 *basalis* weevils about 10 cm. directly under the burrow entrance. Beneath the holding cell the burrow angled off at about 80° to the horizontal. There was only one cell in this nest, 23 cm. below the surface, and 13 cm. from a perpendicular line from the burrow entrance. It contained 70 *basalis* weevils and one small miltogrammine maggot. I could find no trace of the wasp egg; presumably it had been destroyed by the maggot. I continued this excavation to a depth of 30 cm. and a radius of 15 cm. but found no additional cells. The miltogrammine maggot finished feeding and pupated on the morning of July 1.

The entrance of 62362 A was closed all day on June 28, and was still closed the morning of June 29. I assumed that the wasp had made a final closure, so I dug up this nest at mid-morning on the 29th. The shallowest cell was 18 cm. below the surface and under the burrow entrance; it contained 69 *basalis,* some of which had been hollowed out, but no wasp egg or larva. The next cell was 22 cm. below the surface and 10 cm. WSW of a perpendicular line from the burrow entrance; I did not recover all of the prey fragments, but did collect one small black weevil, *Limnobaris confusa* (Boheman), 3.5 mm. long, and 13 entire *basalis* weevils, as well as 42 pairs of *basalis* elytra. Again, there was neither wasp egg nor larva, but many of the weevils had been hollowed out, presumably by miltogrammine maggots which had already left the cell. The deepest cell was at the 23–cm. level and 15 cm. WSW of a perpendicular line from the burrow entrance. I did not recover all the weevil fragments, but all were of *D. basalis* and included 51 whole weevils, many of which had been hollowed out, and 7 pairs of elytra. This cell, like the other two, presumably had been parasitized by Miltogrammini. I continued the excavation to a depth of 50 cm. and a radius of 30 cm. from the entrance, but I could find no other cells.

On June 30 I began making observations at the Arcadia site, 35 miles to the west. The emergence may have been somewhat later in this area, because there were a number of *blakei* males visiting flowers at Arcadia, whereas I had seen none of them at Lake Annie from June 22 to 29 or on July 5. At 1340 I captured a female *blakei* (63062 C) carrying a *basalis* weevil, and I released her after confirming her identity. Her burrow entrance, 3 mm. in diameter, was near a small prostrate plant on a slightly sloping sand bank. There was no spoil heap around the burrow entrance. This wasp continued to store weevils on July 1. Her burrow entrance was still open at 0845 on July 2, and again at 1015 when I began to dig up the nest. Apparently she had completed the nest, but did not fill in the entire burrow, because there was no trace of the main or lateral burrows below the 7–cm. level. This upper section of 7 cm. went downward at an angle of 60°. The shallowest cell was at the 22–cm. level, 10 cm. SE of a perpendicular line from the entrance; it contained 48 *basalis,* and 9 other weevils, *Anthonomus sexguttatus* Dietz, 2.3–2.5 mm. long; I did not recover the wasp egg and there was no evidence of infestation by Miltogrammini. The next cell was at the 24–cm. level, 10 cm. W of the perpendicular line from the entrance; it contained a miltogrammine maggot, 11 *basalis* and 31 *sexguttatus* weevils. The third cell was also at the 24–cm. level, 10 cm. WSW of the perpendicular line from the entrance; it contained a partially grown wasp larva, which I decapitated during the dig, and 25 pairs of elytra from two species of weevils, mostly *A. sexguttatus* but a few *Hyperodes* sp., and also the freshly dismembered parts of two chrysomelid beetles, *Graphops floridana* Blake, 4.5 mm. long. I continued this excavation to a depth of 30 cm. and a radius of 20 cm. from the entrance, but I found no other cells. Probably the Arcadia *blakei* were using other weevils in addition to *basalis,* because there were no palmetto blooms available to concentrate the *basalis.*

At 0835 on July 4 I found the nest of another *blakei* (7462 A), just a meter from that of 63062 C. The entrance was still open when I began to dig up this nest at 1230. I captured the wasp when she flew out of the nest 15 minutes later. The burrow had a diameter of 3.5 mm. at the entrance. It went downward at an angle of about 75° for 16.5 cm. At this point, 14.5 cm. below the surface, I found 4 *basalis* and 1 *sexguttatus* in the holding cell. The first cell which was only partially stored, was at the 18-cm. level, 12 cm. SE of a perpendicular line from the entrance. It contained 8 *basalis* and 8 *sexguttatus* weevils, and 1 chrysomelid, *Graphops floridana* Blake, 4 mm. long, but no wasp egg. I continued this excavation to a depth of 25 cm. and a radius of 20 cm. from the entrance, but found no other cells.

At 0900 I saw another *blakei* (7462 B) hunting around the base of a small plant. I captured her with her prey, just as she started to fly off with it. The latter was a tenebrionid beetle, *Blapstinus interruptus* (Say).

F. E. Kurczewski captured a female *blakei* on July 15, at Venus, several miles south of the Archbold Biological Station. She was carrying a *basalis* weevil.

Although I have recorded several specimens of Chrysomelidae and Tenebrionidae as prey of *blakei,* the available data clearly indicate a strong preference for Curculionidae. Perhaps beetles of other families are taken only (inadvertently?) when weevils are scarce.

Reference was made above to parasitism of *blakei* by miltogrammine flies. I never observed any of these flies trailing a prey-laden wasp to her burrow. However, on two successive mornings I saw from one to three of these flies perched on grass stems near the burrow of 62362 A observing the nesting activities. Subsequently, when this nest was excavated, each of the three cells contained hollowed-out specimens of prey whose appearance was consistent with infestation by miltogrammine maggots. Two of the cells from other nests (62762 B, 63062 C) which I dug up contained one miltogrammine maggot each. Of the seven completely provisioned cells which I recovered, apparently five had been parasitized by Miltogrammini.

Cerceris blakei belongs to the Rufinoda Group, which Banks (1947, p. 26) erroneously identified with the subgenus *Apiraptrix* Shestakov. Unfortunately we have no biological data on any of the species most closely related to *blakei.* As a matter of fact, there are only limited data on two other members of the Rufinoda Group, *rufinoda* Cresson and *finitima* Cresson as reported by Strandtmann (1945, pp. 311–312, figs. 9–10). These two species are the same size as *blakei.* Strandtmann found a partially stored cell of *rufinoda* in gravelly clay soil in Ohio; the steep burrow was about 9 cm. long and ended in a cell about 6 cm. beneath the surface containing 36 tiny, gray weevils, *Tychius picirostris* F. His nest of *finitima* was a partially stored, enlarged cell in sandy clay soil at the end of a vertical burrow about 5 cm. long; the cell contained 9 tiny black flea beetles, *Chaetocnema pulicaria* Melsh. The cells of these species were at a much shallower level than those of *blakei.* Since they were only partially stored, a possibility exists that each represented a holding cell rather than a cell in which an egg would be deposited. However, some species of *Cerceris* do nest at shallow depth: For example, *nigrescens* Smith, which Krombein (1938, pp. 1–2) reported as provisioning cells at depths of 2.5–7.5 cm.

I am indebted to T. J. Spilman, G. B. Vogt, and R. E. Warner of the Entomology Research Division, U. S. Department of Agriculture, for determinations of the coleopterous prey of *Cerceris blakei,* and to L. J. Brass of the Archbold Biological Station, for identification of the plants. F. E. Kurczewski of the Department of Entomology, Cornell University, has kindly furnished a prey record for *blakei* from Venus, Fla., several miles south of the Station.

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SYNOPSIS OF THE KNOWN MEXICAN SPECIES OF *ANEFLUS* (COLEOPTERA: CERAMBYCIDAE)

By J. A. Chemsak and E. G. Linsley[1]

When Bates reviewed the Cerambycidae of Mexico in the Biologia Centrali-Americana (1880–1885), no species of *Aneflus* was known from the Mexican mainland, although LeConte (1873) had described one species from the Cape Region of Baja California. Subsequently, Bates (1892) assigned two new species to the genus, one of which (*A. cylindricollis*) was incorrectly transferred to *Aneflomorpha* by Casey (1912). The other (*A. fulvipennis*) is now the type of *Meganeflus* Linsley (1961).[2] Several additional species were described or recorded from Mexico by Linsley (1936). Franz (1954) added two species from El Salvador. *Aneflus zilchi* Franz can probably be assigned to the subgenus, *Protaneflus,* the males of which possess 12-segmented antennae. The other species, *Aneflus protensus planus* Franz has no close affinities to *protensus* and should be regarded as a good species also in the subgenus *Protaneflus.* Including the six new species herein described, 17 species are now assignable to the genus as it is currently defined, almost all of which are now known to occur in Mexico. The remainder (except *A. zilchi* and *A. planus*) have been included in the key presented below, since they may reasonably be expected to occur within the boundaries of that country. The species now known from America north of the Mexican boundary have been treated elsewhere by Linsley (1963).

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[2] In this genus the integument is shining and glabrous and the antennal scape possesses a distinct apical cicatrix. Through a typographical error, the original description reads "pubescent" rather than "not pubescent." The lack of pubescence is an important feature.

Genus *Aneflus* LeConte

Aneflus Le Conte, 1873, Smithsonian Misc. Coll. 11(264) : 185; ibid. (265) : 302; LeConte and Horn, 1883, Smithsonian Misc. Coll. 26(507) : 287; Leng, 1885, Ent. Amer. 1 : 34; Horn, 1885, Ent. Amer. 1 :131; Casey, 1912, Memoirs on the Coleoptera, 3 : 291; Bradley, 1930, Manual of the Genera of Beetles, p. 233; Linsley, 1936, Ann. Ent. Soc. Amer. 29 :468, 469; Linsley, 1961, Pan-Pacific Ent. 37 : 181; Linsley, 1963, Univ. California Publs. Ent. 21 : 29.

Form elongate, subcylindrical, a little depressed. Head concave and narrowly channeled between antennal tubercles; palpi unequal, last segment expanded; eyes coarsely faceted; antennae with basal segments spinose at apex, outer segments beginning with fourth or fifth flattened and usually expanded externally, beginning with fourth, fifth, or sixth obtusely carinate. Pronotum subcylindrical, sides a little convex, unarmed; disk dull, usually densely punctured or rugose; prosternum with coxal cavities closed or open behind by less than apical width of intercoxal process. Legs moderately slender; femora not clavate, unarmed at apex. Elytra pubescent, the pubescence sometimes interrupted by denuded lines or small round dots; apices emarginate, bispinose or trispinose.

Type species: *Elaphidion protensum* LeConte.

The form of the antennae and the nature of the pubescence distinguish this genus from its relatives (for further comparisons, see Linsley, 1961). Most of the species are large, ranging in length from 24 to 36 mm., although individual specimens of one or two species may not exceed 19 or 20 mm. The species may be distinguished as follows:

KEY TO THE SPECIES OF ANEFLUS

1. Elytral pubescence uniform, short, depressed and usually inconspicuous; antennae of males 12-segmented; color dark brownish testaceous 2

Elytral pubescence irregular, usually dense, conspicuous, often condensed into patches or stripes, if pubescence sparse, erect hairs abundant; antennae of males 11-segmented; color dark reddish brown to piceous 5

2(1) Third and fourth antennal segments subequal in length, or third only slightly longer than fourth; head not asperately punctate 3

Third antennal segment twice as long as fourth; head grossly asperate punctate. Length, 30 mm. Vera Cruz *cylindricollis*

3(2) Elytral pubescence uniform, fine, very short, appressed, not interrupted by rows of round denuded spots with a coarse puncture each bearing an erect seta 4

Elytral pubescence dense, coarse, obscuring surface, interrupted by rows of round denuded spots each enclosing a coarse puncture bearing an erect seta; pronotum densely pubescent, surface obscured; twelfth antennal segment of male only slightly shorter than eleventh. Length, 24–32 mm. Yucatan . . . . *glabropunctatus*

4(3) Each elytron with two costae; twelfth segment of male antennae about one-half as long as eleventh. Length, 21–30 mm. San Luis Potosi . . . . *minutivestis*

Elytra without costae; twelfth segment of male antennae only slightly shorter than eleventh. Length, 28–30 mm. British Honduras to Vera Cruz . . . . *pubescens*

5(1) Elytral pubescence interrupted by three longitudinal, glabrous lines or by rows of round, denuded spots, each enclosing a large puncture bearing a coarse suberect hair 6

Elytral pubescence uniform, or variegated with irregular patches of depressed hairs, not interrupted by longitudinal, glabrous lines or rows of round, denuded spots 8

6(5) Elytral pubescence interrupted by three longitudinal, glabrous lines 7

Elytral pubescence broken by rows of round denuded spots, each enclosing a large puncture bearing a suberect seta; anterior coxal cavities closed, or practically closed, behind. Length, 22–27 mm. Baja California, southwestern United States to Texas, Sonora and Tamaulipas. . . . . *prolixus*

7(6) Intercoxal process of prosternum obtusely expanded at apex, the coxal cavities open behind by about width of apex of prosternal process; antennae shorter than the body in both sexes, segments beginning with fourth expanded externally and carinate. Length, 22–30 mm. Western Texas to Arizona and Sonora . . . . . *sonoranus*

Intercoxal process of prosternum expanded and more or less truncate at apex, the coxal cavities closed or essentially closed behind; antennae longer than the body in the male, segments beginning with fifth flattened, excavated, carinate, but scarcely expanded externally. Length, 19–22 mm. Arizona .... *levettei*

8(5) Elytral pubescence usually dense, variegated with patches of condensed hairs; suberect hairs indistinct, not numerous 9

Elytral pubescence consisting chiefly of short suberect hairs, condensed pubescence, if present, sparse, indistinct; pronotum densely, transversely rugose. Length, 27–38 mm. Baja California to Arizona and Sinaloa .... *calvatus*

9(8) Outer segments of antennae with a very distinct elevated carina; last antennal segment of male moderately to heavily appendiculate; elytral pubescence distinctly condensed into patches 10

Outer segments of antennae vaguely carinate, carinae not prominently elevated; last antennal segment of male very distinctly appendiculate, almost divided; short appressed pubescence more uniform throughout. Length, 25–31 mm. Southern California to Texas and northern Mexico (Sonora, Coahuila, Tamaulipas) .... *protensus*

10(9) Antennal scape feebly emarginate on underside of apex; basal punctures of elytra coarse, dense, subconfluent 11

Antennal scape strongly emarginate on underside at apex; basal elytral punctures small, irregularly placed, well separated; color reddish-brown, pubescence fulvous, pubescent patches coalescing. Length, 29–31 mm. Sinaloa .... *basicornis*

11(10) Humeri not prominent, without a deep impression along base of elytra at insides of humeri; discal tubercles at base of pronotum not very prominent or highly elevated 12

Humeri prominent, base of elytra deeply impressed between humeri and scutellum; discal tubercles at base of pronotum very prominent, highly elevated, glabrous; pubescence white; base of elytra very densely, coarsely, confluently punctate. Length, 30 mm. Mexico .... *humeralis*

12(11) Intercoxal process of prosternum rounded or subtruncate at apex, not notched medially; pubescence of pronotum sparse to dense, usually not obscuring surface; pubescence gray to fulvous 13

Intercoxal process of prosternum rounded at apex, deeply notched medially; pubescence of pronotum dense, at least partially obscuring surface; pubescence white; basal elytral punctures moderately coarse, irregular, confluent and separated. Length, 28–31 mm. Chiapas, Oaxaca, Veracruz .... *nivarius*

13(12) Third antennal segment shorter than or subequal in length to fourth segment 14

Third antennal segment distinctly longer than fourth; pronotum irregularly, transversely rugose; integument dark piceous, pubescence grayish. Length, 25–37 mm. Sonora to Colima and Mexico .... *rugicollis*

14(13) Vestiture of elytra consisting only of dense patches of white-fulvous pubescence, surface mostly obscured; pronotum densely pubescent, surface obscured except for calluses. Length, 28–31 mm. Yucatan .... *variegatus*

Vestiture of elytra consisting of short recurved hairs with small patches of appressed fulvous pubescence not obscuring surface; pronotum thinly pubescent. Length, 29–40 mm. Arizona .... *paracalvatus*

Aneflus (*Protaneflus*) *cylindricollis* Bates

Aneflus cylindricollis Bates, 1892, Trans. Ent. Soc. London 1892: 147, pl. 5, fig. 2; Linsley, 1936, Ann. Ent. Soc. Amer. 29: 471.
Aneflomorpha cylindricollis, Casey, 1912, Memoirs on the Coleoptera 3: 293.

This species resembles *A. pubescens* Linsley in coloration and type of pubescence. It differs by having the third antennal segment twice as long as the fourth in the female, and by the grossly asperate punctures of the head. The male is unknown but presumably falls in the group having 12-segmented antennae.

Type locality.—Jalapa, Vera Cruz.

Aneflus (Protaneflus) glabropunctatus Chemsak and Linsley, sp. n. (Plate 1)

Male.—Form elongate, cylindrical, moderate sized, piceous, elytra pale brownish; pubescence fulvous, dense, moderately coarse, interrupted on elytra by rows of round denuded spots enclosing a puncture bearing an erect seta. Head densely, shallowly, not coarsely punctate, densely pubescent; antennae longer than body, 12-segmented, segments distinctly narrowed basally giving the outside edge a sinuate appearance, segments 3 to 7 spinose at apex, outer segments prominently carinate, pubescence very short, fine, dense. Pronotum slightly longer than broad, subcylindrical, base impressed; disk somewhat convex, dorsal calluses vague, punctures shallow, slightly rugose; pubescence dense, obscuring surface except for elongate, postmedian, glabrous callus; prosternum impressed, transversely rugose, densely pubescent; meso- and metasternum sparsely punctate, densely pubescent. Elytra over three times as long as broad, tapering apically; basal punctures coarse, dense; pubescence dense, obscuring surface except for rows of round, denuded spots with coarse punctures each bearing an erect seta; lines extending length of suture and spines darker; apices bispinose; scutellum densely clothed with white appressed pubescence. Legs slender; femora very densely, finely punctate, densely pubescent. Abdomen sparsely punctate, very densely clothed with pale appressed pubescence; apex of fifth sternite emarginate. Length, 25–28 mm.

Female.—Antennae 11-segmented, not extending beyond first abdominal segment; apex of fifth abdominal sternite sub-truncate. Length, 32 mm.

Types.—*Holotype* male, *allotype* female (American Museum of Natural History) and nine *paratypes* (male) from Pisté, Yucatan, Mexico, 3–5 June 1959 and 8–10 June 1959 (P. and C. Vaurie); additional paratypes as follows: 1 ♂, Pisté, 8 June 1959 (E. C. Welling); 1 ♂, Pisté, 6 Dec. 1950 (E. C. Welling); 1 ♂, Merida, Yucatan, 12 May 1960 (E. C. Welling); 1 ♂, Uxmal, Yucatan, 16–18 June 1959 (P. and C. Vaurie).

This species differs from others in the subgenus by the much denser pubescence which is interrupted by round denuded elytral spots.

Aneflus (Protaneflus) minutivestis Chemsak and Linsley, sp. n.

(Plate 1)

Male.—Form elongate, subcylindrical; integument dark reddish-brown, but with head, prothorax, and appendages piceous; pubescence very fine, short, appressed and suberect. Head moderately coarsely, very shallowly, punctate; pubescence moderately dense, yellowish, mostly depressed; antennae 12-segmented, shorter than body, segment finely, densely pubescent, three to seven spinose at apex, third and fourth subequal in length, outer segments vaguely carinate, twelfth about one-half as long as eleventh. Pronotum cylindrical, a little longer than broad, sides feebly rounded; disk very shallowly punctate, slightly, shallowly rugose transversely;

pubescence fairly sparse, depressed, with fewer longer suberect hairs interspersed; prosternum transversely impressed, coarsely, sparsely punctured and transversely rugose, anterior coxal cavities wide open behind; meso- and metasternum finely, sparsely punctate, densely pubescent; scutellum rounded, densely clothed with white pubescence. Elytra more than three times as long as broad, narrower apically; basal punctures coarse, dense, subcontiguous, becoming finer and sparser apically; each elytron with two costae which do not extend to apex; pubescence very short and fine, appressed, with numerous short and long, suberect hairs interspersed; apices bispinose, outer spine longer. Legs slender; femora very densely, finely punctate, densely pubescent. Abdomen finely, sparsely, irregularly punctate, pubescence dense, both short and depressed and long and suberect; apex of fifth sternite shallowly emarginate. Length, 21–23 mm.

Female.—Much more robust than male; antennae extending to a little beyond mid-elytra, 11-segmented; each elytron with a third costa extending obliquely from base of subsutural costa to suture; apex of fifth abdominal sternite rounded. Length, 29 mm.

Types.—*Holotype* male (California Academy of Sciences) from Tamazunchale, San Luis Potosi, Mexico, 28 Mar. 1956 (D. H. Janzen); *allotype* female (University of Kansas) from El Salto, San Luis Potosi, Mexico, 17 June 1955 (University of Kansas Mex. Exped.); one male *paratype* from Tenosique, Tabasco, Mexico, Feb., 1945 (M. Guerra).

The costate elytra will readily distinguish this species from *A. pubescens* Linsley. It differs from *A. cylindricollis* Bates by the longer fourth antennal segment of the female and the punctation of the head.

Aneflus (*Protaneflus*) *pubescens* Linsley

Protaneflus pubescens Linsley, 1934, Psyche 41: 233.
Aneflus (*Protaneflus*) *pubescens*, Linsley, 1961, Pan-Pacific Ent. 37: 181.

This species is a rather pale reddish-brown with darker head, prothorax, and appendages. The pubescence is very short, fine, recumbent and uniform. The elytra lack distinct costae and the twelfth antennal segment of the male is subequal to or only slightly shorter than the eleventh.

Type locality.—Punta Gorda, British Honduras.

Linsley (1961) lists the range of *pubescens* as Guatemala to Panama. A single female specimen is at hand from Cordoba, Vera Cruz, Mexico (A. Fenyes); 3 males, Cayuga, Guatemala, April-

May, 1915 (W. Schauss); 1 male, Barro Colorado Island, Canal Zone, May, 1941 (J. Zetek).

Aneflus prolixus LeConte

Aneflus prolixus LeConte, 1873, Smtihsonian Misc. Coll. 11(264): 203; Linsley, 1963, Univ. California Publs. Ent. 21: 31.

This species may be easily recognized by the dense pubescence which is interrupted by rows of round, glabrous spots each bearing a coarse puncture giving rise to an erect seta.

A. prolixus segregates geographically into subspecies as follows:

Aneflus prolixus prolixus LeConte

Aneflus prolixus LeConte, 1873, Smithsonian Misc. Coll. 11(264): 203; Leng, 1885, Ent. Amer. 1: 35; Horn, 1885, Ent. Amer. 1: 132; Linsley, 1936, Ann. Ent. Soc. Amer. 29:470; Linsley, 1942, Proc. California Acad. Sci. (4)24: 36.

Aneflus prolixus prolixus, Linsley, 1963, Univ. California Publs. Ent. 21: 32.

In this subspecies the pubescence is very fine, dense, and short. Also, the hairs of the elytra are uniform except for the round, denuded spots, and the antennae of the male are usually about as long as the body. Length, 20–26 mm.

Type locality.—Cape San Lucas, Baja California.

From all indications, this subspecies appears to be restricted to Baja California. Material has been seen as follows: 4 ♂♂ 1 ♀, Triunfo, 13 July 1938 (Michelbacher and Ross); 1 ♂, six miles N. Triunfo, 15 July 1938 (Michelbacher and Ross); 1 ♂, Las Animas, Sierra Laguna, 12 Oct. 1941 (Ross and Bohart); 2 ♂♂, 20 miles NW La Paz, 16 July, 1938 (Michelbacher and Ross); 1 ♂, Arroyo Seco, 6 Oct. 1941 (Ross and Bohart).

Aneflus prolixus fisheri Knull

Aneflus fisheri Knull, 1934, Ohio Jour. Sci. 34: 335.

Aneflus prolixus, Linsley, 1936, Ann. Ent. Soc. Amer. 29: 470; Linsley, 1942, Proc. California Acad. Sci. (4)24: 36; Linsley, Knull, and Statham, 1961, Amer. Mus. Nov. 2050: 13 (record).

Aneflus prolixus fisheri, Linsley, 1963, Univ. California Publs. Ent. 21: 32.

The coarser, denser, more irregular pubescence differentiates this subspecies from the typical form. Additionally, the integument is a darker piceous and the male antennae are shorter than the body. Length, 24–28 mm.

Type locality.—Globe, Arizona.

The distribution of *fisheri* ranges from southeastern Arizona to Durango along the western side of the continental divide. Mexican material has been examined as follows: 2♂♂, 1♀, Desemboque, Sonora, 1–15 Aug. 1953 and 1–10 Sept. 1953 (B. Malkin); 3♂♂, 1♀, six miles NE El Salto, Durango, 10 Aug. 1947 (D. Rockefeller Exp. Michener).

Aneflus prolixus insoletus Chemsak and Linsley, subsp. n.

Form and size of *prolixus prolixus,* integument dark piceous; antennae of male about as long as body, spines small, that of fourth segment distinctly finer than spine of third segment; pubescence dense, not coarse, fairly long, appressed. Length, 21–26 mm.

Types.—*Holotype* male (California Academy of Sciences) and two male *paratypes* from 29 km. S. Hidalgo, Tamaulipas, Mexico, 11 July 1952, "ebony scrub" (F. W. and G. W. Werner); additional *paratypes* as follows: 3♂♂, eight miles N. Jimenez, Tamaulipas, 15 June 1953 (Univ. Kansas Mex Exped.); 1♂ 1♀, Abasolo, Tamaulipas, 17 May 1952 (M. Cazier, W. Gertsch, R. Schrammel); 3♂♂, San Fernando, Tamaulipas, 27 Aug. 1954 (C. D. Michener and party); 2♂♂, San Fernando, 26 Aug. 1951; 1♂, La Gloria, S. of Monclova, Coahuila, 24 Aug. 1947 (Michener); 2♂♂, 167 km. E. San Luis Potosi, San Luis Potosi, 3 July 1948 (Werner and Nutting); 1♀, San Pedro de Colonas, Coahuila, 20 Aug. 1947 (Cazier); 1♂, Jacala, Hidalgo, 6 July 1939; 4♂♂, Pedricena, Durango, 19 Aug. 1947 (Cazier); 2♂♂, San Juan del Rio, Durango, 30 July 1947 (Cazier); 2♂♂, 20 miles SW Camargo, Chihuahua, 13 July 1947 (Gertsch, Schrammel).

This subspecies differs from the others by the nature of the pubescence. The hairs are longer and thicker than in *prolixus* and denser and finer than in *fisheri.* The form is generally less robust than *fisheri,* and the male antennae longer, with smaller spines.

This population occurs from the east side of the continental divide to the coast and as far south as Hidalgo.

Aneflus sonoranus Casey

Aneflus sonoranus Casey, 1924, Memoirs on the Coleoptera, 11: 241; Linsley, 1936, Ann. Ent. Soc. Amer. 29: 470, pl. 1, fig. 5, 5a; Linsley, Knull, and Statham, 1961, Amer. Mus. Nov. 2050: 13 (record); Linsley, 1963, Univ. Calif. Publ. Ent. 21: 30.

Axestinus obscurus Leng (nec LeConte), 1885, Ent. Amer. 1, pl. 2, fig. 27; Schaeffer, 1908, Bul. Brooklyn Inst. Arts Sci. 1: 335 (Misident.).

This species may be readily recognized by the three longitudinal, glabrous, impunctate lines of the elytra and the posteriorly closed anterior coxal cavities.

Although no material from Mexico is at hand, *A. sonoranus* undoubtedly occurs in Sonora and perhaps elsewhere.

Aneflus levettei (Casey)

Elaphidion levettei Casey, 1891, Ann. New York Acad. Sci. 6:29; Hamilton, 1896, Trans. Amer. Ent. Soc. 23: 167.

Aneflus levettei, Schaeffer, 1908, Bul. Brooklyn Inst. Arts Sci. 1: 335; Casey, 1924, Memoirs on the Coleoptera, 11: 241, 242; Linsley, Knull, and Statham, 1961, Amer. Mus. Nov. 2050: 13 (record); Linsley, 1963, Univ. California Publs. Ent. 21: 31.

Aneflomorpha levettei, Casey, 1912, Memoirs on the Coleoptera, 3: 293; Linsley, 1936, Ann. Ent. Soc. Amer. 29: 475.

A. levettei may be separated from *A. sonoranus,* which it closely resembles, by the posteriorly open front coxal cavities. The form is also narrower and less robust. Although available specimens are all from montane areas of Arizona, the species may extend into Mexico.

Aneflus calvatus Horn

Aneflus calvatus Horn, 1885, Ent. Amer. 1: 132; Linsley, 1936, Ann. Ent. Soc. Amer. 29: 471; Linsley, 1942, Proc. California Acad. Sci. (4)24: 37; Linsley, 1963, Univ. California Publs. Ent. 21: 36.

The robust form, piceous color, short inconspicuous pubescence consisting chiefly of suberect hairs, and the strongly wrinkled pronotum, distinguish this species.

Type locality.—Arizona.

A. calvatus ranges from about the middle of Baja California to Arizona and south to Sinaloa. Mexican records as follows: 1 ♂, 15 miles N. San Ignacio, Baja California, 27 July 1938 (Michelbacher and Ross); 2 ♂♂ 1 ♀, 45 miles N. San Ignacio, 27 July 1938 (Michelbacher and Ross); 1 ♀, 5 miles NW Punta San Felipe, Baja California, 9 July 1955 (J. P. Slevin); 1 ♀, San Bernardino, Rio Mayo, Sonora, 18 Aug. 1935 (B. S. Gentry); 1 ♀, Alamos, Sonora, 22 Aug. 1959 (R. L. Westcott); 1 ♀, 26 miles N. Pericos, Sinaloa, 13 Aug. 1960 (Arnaud, Ross, and Rentz).

Aneflus protensus (LeConte)

Elaphidion protensum LeConte, 1858, Proc. Acad. Nat. Sci. Philadelphia, p. 82.

Aneflus protensus, LeConte, 1873, Smithsonian Misc. Coll. 11 (264) : 185; Leng, 1885, Ent. Amer. 1: 34, pl. 3, fig. 5; Horn, 1885, Ent. Amer. 1: 131; Linsley, 1936, Ann. Ent. Soc. Amer. 29: 470; Linsley, 1942, Proc. California Acad. Sci. (4)24: 36; Linsley, Knull, and Statham, 1961, Amer. Mus. Nov. 2050: 13 (record); Linsley, 1963, Univ. California Publs. Ent. 21: 32.

Aneflus cochisensis Casey, 1912, Memoirs on the Coleoptera, 3: 296.

Color piceous; pubescence fairly uniform, condensed patches small, numerous, giving a somewhat speckled appearance. Antennal carinae feeble, not prominently elevated.

Type locality.—Sonora, Mexico.

The distributional range of this species extends from Baja California to Texas and northern Mexico. Mexican material examined: 2 ♂♂, Desemboque, Sonora, 20–31 Aug. 1953 (B. Malkin); 1 ♂, 16 miles SW Hermosillo, Sonora, 21 July 1950 (J. P. Figg-Hoblyn); 1 ♀, Navajoa, Sonora, 24 June 1956 (R. and K. Dreisbach); 3 ♂♂, San Bernardino, Rio Mayo, Sonora, 26 June 1935; 1 ♂, Guaymas, Sonora, 13 June 1954 (C. Dodson); 1 ♂, 42 miles SW Camargo, Chihuahua, 15 July 1947 (Cazier); 6 ♂♂, 12 miles N. Hermanas, Coahuila, 11 Aug. 1959 (L. A. Stange, A. S. Menke); 2 ♂♂, Coahuila, July, 1952; 1 ♂, 43 km. E. Mante, Tamaulipas, 27 May 1948 (Nutting and Werner); 1 ♂, Abasolo, Tamaulipas, 17 May 1952 (M. Cazier, W. Gertsch, R. Schrammel).

Aneflus basicornis Linsley

Aneflus basicornis Linsley, 1936, Ann. Ent. Soc. Amer. 29: 471, pl. 1, fig. 9.

The strongly emarginate apex on the underside of the scape distinguishes this species. The color is reddish-brown with patches of fulvous pubescence. The pronotum is not strongly rugose but possesses five irregular calluses on the disk.

Type locality.—Venedio, Sinaloa.

This species is known only from the type locality, all specimens (males) taken on 27 July 1918.

Aneflus humeralis Chemsak and Linsley, sp. n.

Male.—Form stout, somewhat compressed; color dark reddish-piceous; pubescence white, appressed, condensed into patches. Head irregularly, shallowly punctate; antennal tubercles prominent; pubescence somewhat sparse, rather long, depressed; antennae extending to about apex of fourth antennal segment, segments three to seven spinose at apex, carinae prominent beginning with sixth segment, basal segments densely white pubescent, outer segments clothed with very short appressed pubescence, third segment longer than fourth, fifth longer than third, eleventh segment longer than tenth. Pronotum slightly broader than long, deeply impressed near base behind middle; disk with two very large, prominent calluses at base, one on each side of middle, center longitudinally glabrous, calluses near apex irregular, tranverse rugae prominent; pubescence moderately dense, appressed, with few long erect hairs interspersed; prosternum deeply impressed, coarsely, rugosely punctured behind coxae, intercoxal process narrow, apically expanded, coxal cavities open behind; meso- and metasternum coarsely, densely punctate, pubescence dense, appressed; scutellum densely white pubescent. Elytra less than three times as long as broad; base deeply impressed inside of humeri giving a sinuate appearance; basal punctures coarse, dense, becoming obsolescent toward apex; each elytron bicostate; pubescence consisting of irregular, dense patches of white appressed hairs, longer, suberect hairs few; apices bispinose. Legs moderate, slender; femora densely, moderately coarsely and finely punctate, densely pubescent. Abdomen finely, sparsely punctate, moderately pubescent. Length, 30 mm.

Holotype male (California Academy of Sciences) from Tejupilco, Mexico, Mexico, June, 1933 (Hinton and Usinger).

This species may be recognized by the prominent humeri and the two high calluses near the base of the pronotum.

The type specimen has been partially destroyed by dermestids with the apex of one antenna, elytra near the base, and apex of the abdomen damaged. However, the specimen is distinct enough to permit characterization in spite of the minor damage.

Aneflus nivarius Chemsak and Linsley, sp. n.

Male.—Form robust, somewhat compressed; color dark reddish-brown; pubescence dense, white, appressed, condensed into patches. Head finely, shallowly punctate, white appressed pubescence partially obscuring surface; antennal tubercles not produced apically; antennae extending to fourth abdominal segment, basal segments except scape densely white pubescent, segments three and four subequal in length, fifth longer, segments three to seven spinose at apex, outer segments prominently carinate, eleventh segment longer than tenth, appendiculate. Pronotum broader than long, sides sinuate, impressed behind middle; disk irregular, with five raised calluses, central callus glabrous, irregularly rugose; white appressed pubescence dense, partially obscuring surface; prosternum deeply impressed, rugosely punctate, densely pubescent, intercoxal process narrow, slightly expanded apically, apex rounded, notched medially, coxal cavities open behind; meso- and metasternum moderately coarsely, rather sparsely punctate, densely pubescent; scutellum densely white pubescent. Elytra less than three times as long as broad; basal punctures moderately coarse, irregular, well separated in spots; costae vague, almost not discernible; short, white, appressed pubescence condensed into many irregular patches; apices bispinose. Legs slender; femora finely punctate, densely pubescent. Abdomen finely, densely punctate, very densely pubescent; apex of fifth sternite emarginate. Length, 30 mm.

Holotype male (California Academy of Sciences) from 7 miles W. Tuxtla Gutierrez, Chiapas, Mexico, 2 April 1953 (R. C. Bechtel, E. I. Schlinger). Also tentatively assigned to this species are two males from 23 miles S. Matias Romero, Oaxaca, 5, 22 April 1962 (F. D. Parker, L. A. Stange) and one female from 20 miles S. Veracruz, 16 June 1961 (J. H. Legue). These specimens differ slightly in the elytral punctation from the type and in addition, the front coxal cavities of the female are more widely open behind.

This species is distinctive by the dense white patches of pubescence over the elytra, densely pubescent head and prothorax and by the rounded, medially notched apex of the prosternal intercoxal process.

Aneflus rugicollis Linsley

Aneflus rugicollis Linsley, 1935, Trans. Amer. Ent. Soc. 61: 74.

This species in suggestive of *paracalvatus* except for the piceous color, and denser patches of condensed pubescence. The pronotum is moderately densely pubescent and the third antennal segment distinctly longer than fourth.

Type locality.—Jofutla, Morelas.

Mexican material as follows: 1 ♂, Tejupilco, Mexico, June, 1933 (Hinton and Usinger); 3 ♂♂ 1 ♀, Jesus Maria, Nayarit, 6, 27 July 1955 (B. Malkin); 1 ♂, 26 miles N. Perico, Sinaloa, 13 Aug. 1960 (Arnaud, Ross, Rentz); 1 ♂, Teloloapan, Guerrero, 12 June 1957 (W. Gibson); 1 ♀, Alpuyeca, Morelas, 27 June 1951 (H. E. Evans); 2 ♂♂ 1 ♀, 10 miles W. Alamos, Sonora, 21 July 1954

(Cazier, Gertsch, Bradt). A specimen from Colima was included in the type series.

Aneflus variegatus Chemsak and Linsey, sp. n.

Male.—Form elongate, subcylindrical; color dark reddish-brown; pubescence dense, white-fulvous, appressed, condensed into patches. Head moderately coarsely, shallowly punctate, densely clothed with appressed pubescence; antennal tubercles not prominent, rounded; antennae shorter than body, segments three to six spinose at apex, seventh minutely dentate, carinae of outer segments prominent, basal segments finely, densely pubescent, outer segments densely clothed with very short pubescence, segments three and four subequal in length, fifth longer, eleventh longer than tenth, appendiculate. Pronotum slightly broader than long, widest at middle; disk irregularly rugosely punctate, calluses distinct, median callus gla-

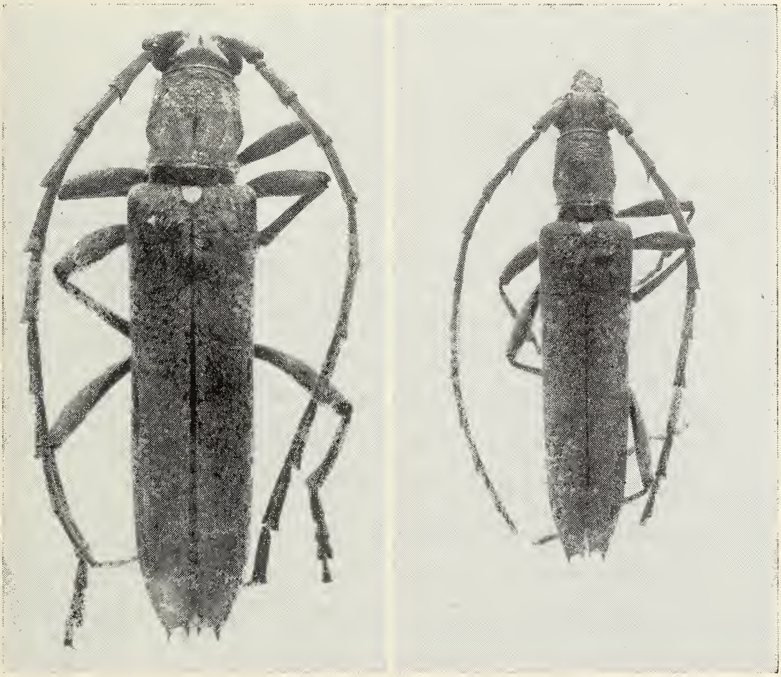

Plate 1. Left: *Aneflus* (*Protaneflus*) *glabropunctatus* Chemsak and Linsley, ♂; Right: *Aneflus* (*Protaneflus*) *minutivestis* Chemsak and Linsley, ♂. × 3.

brous, elongate; appressed pubescence dense, partially obscuring surface, long suberect hairs sparse; prosternum deeply impressed, coarsely, sparsely punctate before coxae, densely pubescent, intercoxal process slightly expanded apically, apex subtruncate, coxal cavities open behind; meso- and metasternum rather finely, not densely punctate, densely pubescent. Elytra about three times as long as broad, surface densely variegated with patches of appressed pubescence, surface partially obscured; basal punctures coarse, dense, irregular, subconfluent; costae vague; apices bispinose; scutellum densely white pubescent. Legs slender; femora finely and moderately coarsely punctate, densely pubescent. Abdomen finely punctate, densely pubescent; apex of fifth sternite emarginate. Length, 28–31 mm.

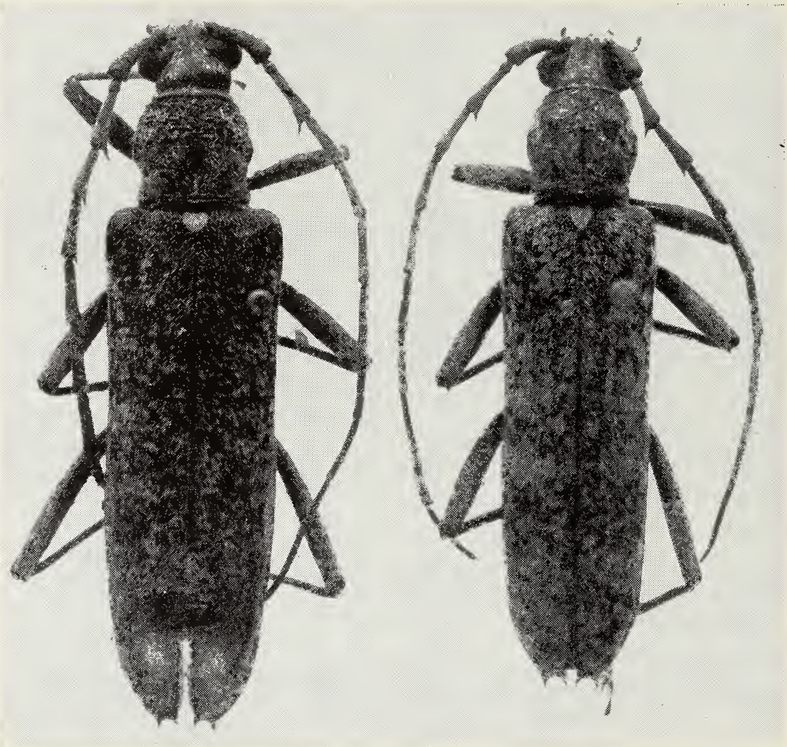

Plate 2. Left: *Aneflus humeralis* Chemsak and Linsley, ♂; Right: *Aneflus variegatus* Chemsak and Linsley, ♂. × 3.

Types.—*Holotype* male (American Museum of Natural History) from Pisté, Yucatan, Mexico, 8–10 June 1959 (P. and C. Vaurie). One male *paratype* from Chichen-Itza, Yucatan.

This species has densely variegated elytra with patches of appressed hairs. It resembles *nivarius* and *rugicollis* but may be distinguished by the characteristics used in the key.

Aneflus paracalvatus Knull

Aneflus paracalvatus Knull, 1955, Ent. News 66: 21; Linsley, 1961, Univ. Calif. Publ. Ent. 21: 33.

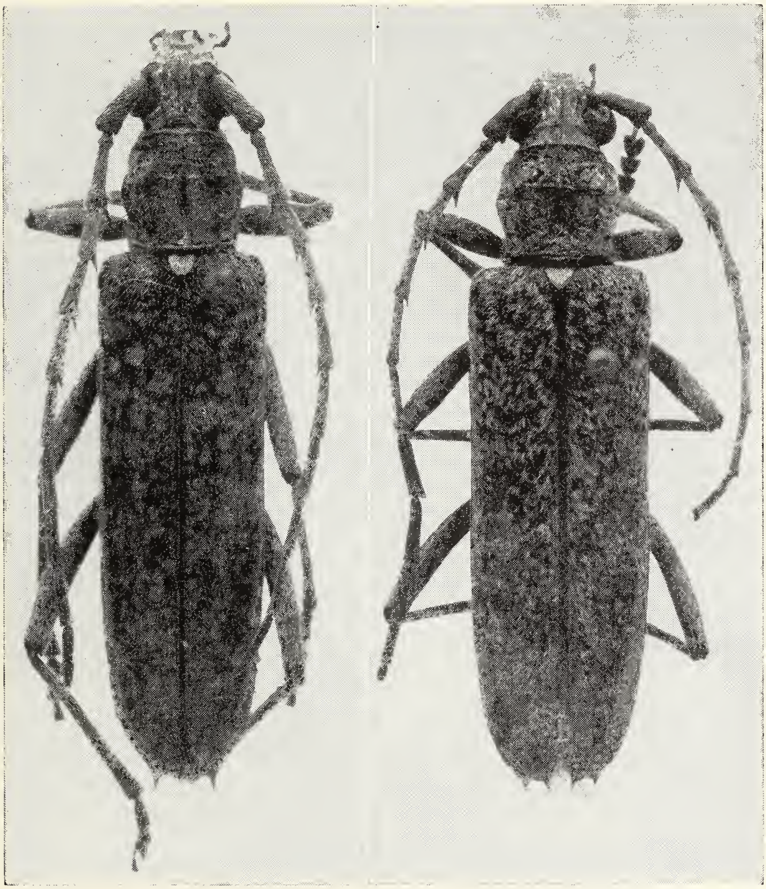

Plate 3. Left: *Aneflus rugicollis* Linsley, ♂; Right: *Aneflus nivarius* Chemsak and Linsley, ♂. × 3.

Aneflus prosopidis Linsley, 1957, Amer. Mus. Nov. 1828: 20.

The robust form, brown color and thin patches of fulvous pubescence separate this species from *calvatus*. The pronotum is thinly pubescent and rugose with a T-shaped, glabrous callus usually present on the disk. The elytra contain very few erect hairs.

Type locality.—Santa Rita Mts., Arizona.

This species is not yet known from Mexico but may occur in the northern portions of the country.

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BULLETIN

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Vol. LVIII OCTOBER, 1963 No. 4

ADDITIONAL NOTES ON DIPTERA (TABANIDAE) FROM DELAWARE[1]

By Donald MacCreary[2]

A list of the Tabanidae of Delaware was published in 1940.[3] Since that time an additional species and subspecies of *Chrysops* have been added through systematic studies by Pechuman.[4] Also the presence of a *Goniops* has been confirmed and a *Chlorotabanus* has been collected for the first time. These notes also report the collection of numerous specimens of *Dichlorus ferrugatus* (Fab.) formerly thought to be rare.

Two females of *Goniops chrysocoma* O.S. were taken by H. E. Milliron in a wooded area near Newark on June 20, 1956. One female of *Chlorotabanus crepuscularis* (Bequaert), determined by Alan Stone, was collected on man near Lewes, August 12, 1957. He states in a personal communication that this is close to the northern record for this species and that a specimen from Garrett Park, Maryland (north of Washington) is in the National Museum.

D. ferrugatus was considered extremely rare in the State when the Delaware list was published. However, some years later New Jersey-type mosquito traps were operated at the margins of Cedar

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[1] Published as Miscellaneous Paper No. 446 with the approval of the Director of the Delaware Agricultural Experiment Station. Publication No. 333 and Scientific Article 349 of the Department of Entomology.

[2] Research Professor, Department of Entomology, Delaware Agricultural Experiment Station, Newark.

[3] **MacCreary, Donald.** 1940. Report on the Tabanidae of Delaware. Del. Agri. Expt. Sta. Bul. 226, 41 pp.

[4] **Pechuman, R. L.** 1949. Some notes on Tabanidae (Diptera) and the description of two new species. Canad. Ent. 81(4): 77–84.

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Swamp in southern Sussex County. Numerous specimens of *ferrugatus* were taken in these traps. Nearly 30 were recovered, most of them during the last 10 days of June. The area where the collections were made is a swamp that in former years was flooded and produced much cypress lumber. Apparently Cedar Swamp, which is actually a "cypress" swamp, is ecologically similar to such swamps in North Carolina and Virginia. In the latter area where the species is extremely common it is known as the "yellow fly of the Dismal Swamp." In 1958 specimens were collected near Bethel in the vicinity of the only known habitat of the pitcher plant, *Sarracenia purpurea,* in Delaware. All of these collection points are in the southern part of the state.

In the list of Tabanidae mentioned above, MacCreary provided the following statement on *Chrysops flavidus* Wiedemann, "An anomalous form of this species is found in Delaware. Wide variations exist within it and it is far more common than the typical *C. flavida.* Many specimens approach *C. brunnea* Hine rather closely. Both C. B. Philip and Alan Stone have examined a considerable series. Since a new variety has not yet been set up, the data presented above for *C. flavida* include this related form."

Since that time the situation has been clarified. In 1949 Pechuman[4] described from this complex a new species, *Chrysops atlantica* Pechuman and a new subspecies, *Chrysops flavidus celata* Pechuman.

Lewis[5] quoted MacCreary on certain habits of *flavidus* in Delaware, discussed Pechuman's new species and indicated that it was not known whether the anomalous specimens from Delaware were *atlantica* or *flavidus celata.*

Recently 261 specimens of this complex, which has been retained from the study of 23 years ago, were examined by Hugo Jamnback as well as by L. L. Pechuman. Of this lot 241 proved to be *atlantica.* Thirteen were identified as *flavidus* and five as *flavidus celata.* Two *brunnea* had been included. Seven of these specimens had been reared from larvae. All reared specimens proved to be *atlantica.*

From this information it would appear that most, if not all, of the rearing data and plant and water relationships discussed by MacCreary[3] under *flavidus* apply instead to *atlantica.* Likewise information on seasonal and geographical distribution and habits would seem to relate very largely to *atlantica.*

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[5] **Lewis, L. F.** 1959. The Biology of *Chrysops flavida* in the Yazoo Mississippi Delta. Jour. Econ. Ent. 52(5): 884–887.

DESCRIPTION OF THE TANYDERID LARVA *PROTANYDERUS MARGARITA* ALEXANDER FROM COLORADO[1]

By Allen W. Knight[2]

While conducting an aquatic invertebrate investigation in Colorado, the author encountered the larvae of a Tanyderid Diptera. These larvae are almost certainly those of the heretofore undescribed *Protanyderus margarita* Alexander. The adult of this rare species is known to occur from Colorado northward and westward into British Columbia, Oregon and Utah (Alexander, personal communication, 1962). The adult of *Protanyderus margarita* Alexander was described by C. P. Alexander from Zion National Park, Utah, and named for his wife, Mabel Marguerite Alexander. It has also been reported from British Columbia, Oregon (N.E., Great Basin area), Idaho, and Colorado (Alexander, personal communication, 1962). The last is the most easterly known record for the species and genus in North America (Sunset, Boulder County, 22 July 1915, T. D. A. Cockerell).

A photograph of the larval Tanyderid was sent to Dr. Alexander for his inspection. He stated that "it is virtually certain from its habitat that the species concerned is *Protanyderus margarita* Alexander."

The only Tanyderidae whose early stages have been described are *Protoplasa fitchii* (Osten-Sacken) in Eastern North America, *Peringueyomyina barnardi* Alexander in South America and *Protanyderus vipio* (Osten-Sacken) discovered in California by Dr. Joseph H. Rose (Alexander, personal communication, 1962) who is describing it.

The author secured a total of three Tanyderid larvae. All were encountered on July 11, 1961, in Blue Creek, Gunnison County, Colorado. The collection was made in a meadow through which Blue Creek flows, approximately one mile above the point where Blue Creek passes under a bridge on High 50. Blue Creek, in this area, is a shallow stream with a depth of 1 to 2 feet, and has a rubble to stony bottom. The immediate shore where the larvae were found has overhanging banks of grass and willow. The stream at this point is mainly riffles. The larvae were found a foot

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[1] Financial support for the research upon which this paper is based came from a National Science Foundation grant (NSF G-20703).

[2] Zoology Department, University of Utah, Salt Lake City, Utah.

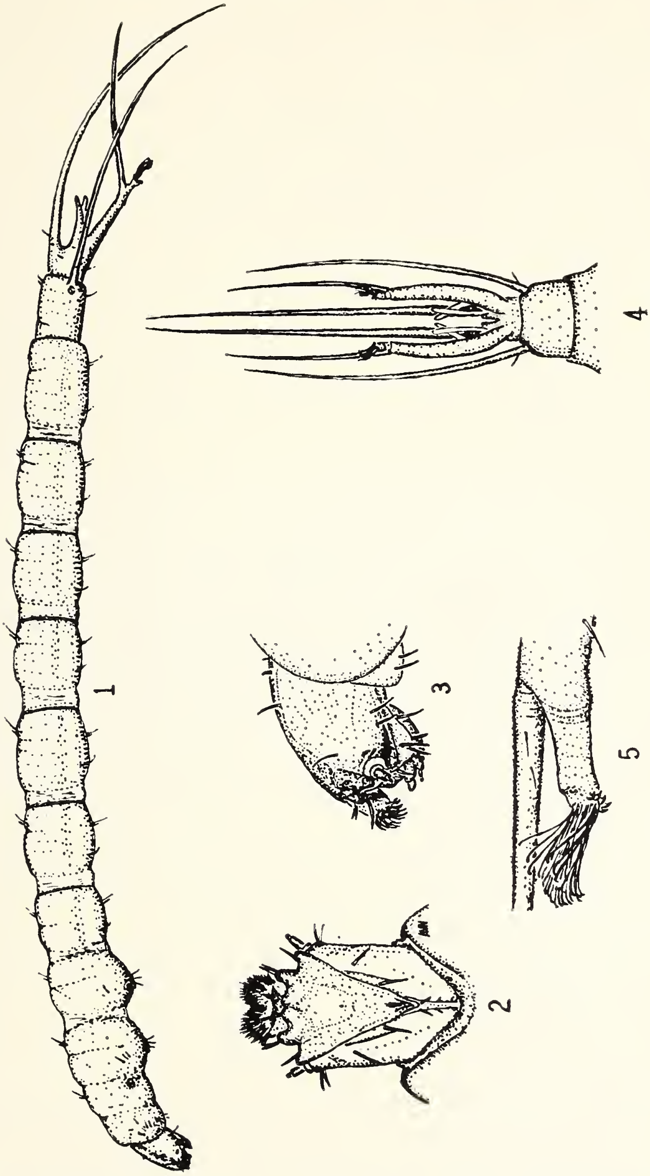
or two from the southern bank in shallow water where the rocky bottom contained considerable sand between and under the stones.

I would like to thank Dr. Charles P. Alexander for his determination of the larvae, as we as his generous supply of data and information pertaining to the Tanyderidae, and Alan V. Nebeker for preparing the excellent figures. Grateful acknowledgment is also made to George F. Edmunds, Jr., Louis T. Nielsen and Arden R. Gaufin, for their aid during the preparation of this paper.

DESCRIPTION OF THE LARVA

The body of the larva is quite midge-like in appearance and is about 12 mm long, exclusive of filaments (total length including filaments, 15–17 mm). The body is yellowish-brown in color and appears nearly white in live specimens. The sclerotized head capsule is of a very complex nature and diverges downward from the main body axis at about a 45° angle. The antennae are three-segmented with the basal segment being the larger and the two distal segments each progressively smaller. Two large lobes of epipharyngeal brushes are borne on the labrum. Ventral to the epipharyngeal brushes are the mandibles, maxillary palpae, maxillary mala and labial sclerite, each in a ventro-posterior position to the preceding structure. The eyes are located just posterior to the base of the antennae. The thoracic segments are swollen and slightly larger than the abdominal segments. The prothoracic segment exhibits a dark brown spiracle on the posterior edge of the lateral margins. The prothorax is divided into an anterior and posterior subdivision. The mesothorax and metathoracic segments also possess this subdivision but it is less defined and restricted, for the most part, to the dorsal portion of the segments. The abdomen is divided into nine distinct abdominal segments that become progressively longer with a gradual reduction in diameter.

The eighth abdominal segment possesses a lateral spiracle near the posterior edge of the segment and just anterior to the origin of a filament that extends posteriorly for about 3 mm. The ninth abdominal segment is produced into a dorsal and ventral pair of posterior projections. The dorsal pair of filments, which are about 4 mm long, are slightly longer than any of the other terminal filaments. The ventral projections are produced into stout "pseudopods" or posterior leg-like structures, about 2 mm long, which project posterolaterally from the ninth segment. A dorsal filament arises from the pseudopods and extends posteordorsally for about 1.5 mm. Each of the pseudopods terminates in a fan-like arrange-



Larva of *Protanyderus margarita* Alex. Fig. 1, Lateral view of entire larva. Fig. 2, Dorsal view of head. Fig. 3, Lateral view of head and prothorax. Fig. 4, Caudal end, ventral aspect of larva. Fig. 5, Lateral view of enlargement of "pseudopod" and crotchets.

ment of 23 contractile crotchet-like structures. Just anterior and ventral to the crotchet-like structures are seven large ventrally curved hooks.

At the base of each pseudopod and slightly posterodorsal is located a pair of gills about ¾ to 1 mm long.

Chaetotaxy.—The dorsal aspect of the head has a pair of setae located on the anterodorsal surface of each torma with a pair of setae dorsal and lateral to each epipharyngeal brush at the anterior of the postclypeus. A pair of setae are located slightly posterior, and a single seta anterior, to the antennae. The frontal sutures are bordered by two pairs of setae with three additional pairs along the coronal suture. A pair of setae project from the paragula just lateral and anterior to another pair located somewhat more ventrally on the paragula. A single seta extends anteriorly from each paragula.

The prothorax has a pair of ventral setae just posterior to the basal labial plate as well as a group of four ambulatory setae on the prothorax, mesothorax and metathorax. The setae behind the metathorax consist of a pair of lateral ventral setae on each segment. Another group of three setae is located on the anterolateral aspect of the prothorax, as well as a single seta just anterior to the spiracle. The remainder of the segments exhibits a prominent single anterior and two less prominent posterolateral setae per segment. A group of four weak setae is distributed across the dorsal aspect of each segment. The eighth abdominal segment possesses a group of three lateral setae just anterior to the filament. A dorsal seta occurs on the dorsal aspect of the lateral filament, shortly beyond its origin.

The morphological terminology utilized in the present description was adapted from descriptions of *Protoplasa fitchii,* set forth by Alexander (1930) and Crampton (1930).

Collection Data.—Larvae, Blue Creek, Gunnison County, Colorado; 11 July 1961 (A. W. Knight), deposited in collection of the University of Utah, Salt Lake City, Utah.

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LARVAE AND PUPAE OF TWO NORTH AMERICAN LIMNEPHILID CADDISFLY GENERA (TRICHOPTERA: LIMNEPHILIDAE).

By Glenn B. Wiggins[1]

Knowledge of the biology of North American caddisflies continues to be impeded by the inability to even identify most of the species in their larval stages. The outstanding example is the family Limnephilidae, in which only about one-half of the 40-odd genera in North America are now recognizable as larvae. It is toward this barrier that some of my studies on Trichoptera are being directed, and the following descriptions are among the results of recent work. Unless otherwise indicated, all material is in the collection of the Department of Entomology and Invertebrate Zoology, Royal Ontario Museum.

Philarctus quaeris (Milne)

This is the only North American species assigned to *Philarctus,* although six others from central Asia are also attributed to this genus by Schmid (1955). The validity of some of these is apparently questionable (Schmid, *op. cit.*).

Larvae of this species, and presumably of this genus, key to *Asynarchus* in the recent study of limnephilid larvae by Flint (1960), and to *Limnephilus,* which includes *Asynarchus* among other genera, in the generic key of Ross (1959). The colour pattern of the head, with three light patches on the base of the frontoclypeus, is common to both *Philarctus* and *Asynarchus,* but the two can be most readily distinguished by the larval cases. The cornucopia-like case of *Asynarchus,* made of conifer needles, bark and leaf fragments, some seeds, but generally elongate pieces of plant material placed obliquely, is distinct from the straight, narrow cylindrical case of shells, seeds and fine gravel constructed by *P. quaeris.* In addition, the ventral surface of the first abdominal segment in *Philarctus* bears something of the order of 50 hairs, while in *Asynarchus* there are about 35 or fewer hairs. The concave anterior margin of the sclerotized plate on the mesonotum of *Philarctus* seems also to be distinct from *Asynarchus.* If Flint's (1960) generalization, that the larval cases in *Limnephilus* are made of plant materials placed longitudinally or transversely, holds then *Philarctus* could be distinguished by the larval case from *Limnephilus s.s.,* too.

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[1] Royal Ontario Museum, University of Toronto.

Larva (Figs. 1, 4, 5).—Head medium brown in colour; pointed basal portion of the frontoclypeus with 3 light patches, one at the confluence of the frontoclypeal and epicranial sutures and extending posteriorly along the epicranial suture for some distance, the other 2 paired, with one lying along each lateral margin; a few dark brown muscle scars in the central area between these light patches. Several rows of conspicuous dark muscle scars present, beginning at about the level of the eyes and extending posteriad. Ventral surface of the head uniform medium brown, with a few dark brown muscle scars around the occipital foramen. Mandibles as shown.

Pronotum mostly medium to light brown, the edges darker. A transverse depression extending across the anterior portion; scattered dark brown muscle scars lying behind this. Long, dark hairs arising from the anterior and lateral areas, and from the central portion; fine, clear hairs along the anterior edge. Prosternal horn shorter than the front coxae, prosternal plate moderately developed, with a very small sclerite at each side. Mesonotum medium to light brown, with dark brown muscle scars, anterior margin conspicuously concave; mesosternum with a transverse row of small, dark sclerites. Metanotum with sclerites typical. Legs typical for the subfamily Limnephilinae.

First abdominal segment with 8–10 black hairs around the base of the median dorsal hump, about 6 hairs around each lateral hump, and 40–50 similar hairs on the ventral surface. Gills long and stout, mostly arising in groups of 2 or 3, arranged as in Fig. 5. An oval sclerotized ring on the ventral surface of segments III to VII inclusive. Sclerite on the dorsum of segment IX light brown, with 4 long hairs and 5 or 6 shorter hairs. A row of tiny bifid processes dorsad of the lateral line. Anal claws with 1 or 2 accessory teeth. Length of mature larva about 15mm.

Pupa (Figs. 6, 7).—The comparative features of limnephilid pupae are so little known that nothing can be added to the details provided by the figures at the present time.

Case (Figs. 2, 3).—The larval case is composed of the shells of small aquatic snails, pieces of larger broken shells, very small rock fragments, or of the seeds of littoral plants. One or another of these different materials is sometimes used exclusively, and sometimes all of them in the same case. Outside of plant seeds, which approximate the mineral materials in shape and texture, other plant materials were not observed in the cases. The arrangement of the individual pieces on the case is quite irregular, but the overall architecture, whatever the materials, is clearly of the same basic type.

The pupal case is apparently the same larval case with the ends stopped up with similar materials, the small interstices covered with a typical sieve membrane of silk.

Habit and Behavior.—Larvae of this species were extremely abundant in most of the small, shallow ponds or sloughs encountered in the aspen parkland area of southern Manitoba and Saskatchewan. Pupation had not begun in early June, but was well advanced by early July, and a few adults were on the wing by that time. The small sloughs, sometimes referred to as pot-holes, around Neepawa and Minnedosa in Manitoba were especially rich in these larvae. Other caddisflies present included *Agrypnia pagetana, Molanna flavicornis, Anabolia bimaculata* and *Triaenodes* sp. The fauna, generally, of these sloughs was extremely rich in crustaceans, copepods, molluscs, mosquitoes and aquatic beetles and bugs. In view of the importance of this area as a breeding ground for ducks, and the abundance and relatively large size of these caddisfly larvae, it is likely that *Philarctus quaeris* comprises a significant part of the food of the ducks.

The larvae were crawling actively over the bottom of the sloughs, on aquatic plants and on various items of debris. There was a general tendency to congregate in the shallower water around the edge of the pond, in depths ranging from a few inches to a foot or so, rather than in the deeper, central areas. Pupae were fastened to almost any type of solid surface, often in very dense aggregations.

Material Examined.—*Manitoba:* Erickson, 10 June 1962, many larvae; 2 July 1962, many larvae, pupae and adults, some larvae and pupae reared. Minnedosa, 10 June 1962, many larvae; 2 July many larvae and pupae, some reared, emerging 12–31 July. Neepawa, 9 June 1962, many larvae. Oakland, 9 June 1962, many larvae. Oak River, 3 July 1962, many pupae, some reared, emerging 10–30 July. Saskatchewan: St. Denis, 16 mi. e. Saskatoon, 14 June 1962, many larvae, some reared, emerging 25 July–16 Aug.

Chyranda centralis (Banks)

The genus *Chyranda* is confined to North America, where several species have in the past been proposed. These were, however, reduced to synonymy in the single species *C. centralis* by Schmid (1951). This species has been recorded previously from Utah, Colorado, British Columbia and Quebec, and is here recorded from the Cypress Hills area in both Alberta and Saskatchewan, from Jasper National Park, Alberta, and from Kootenay National Park in British Columbia.

Larvae of this genus key to *Pseudostenophylax* (= *Drusinus*) in Ross (1959) and in the general key to the eastern limnephilid genera given by Flint (1960, p. 15). *Chyranda* is, however, readily separated from that genus by the very unusual case, by the flattened head, and by the absence of hairs between the posterior sclerites on the metanotum, to mention the more conspicuous distinctions. Moreover, *Chyranda* is a member of the subfamily Limnephilinae, and is further differentiated from the Pseudostenophylacinae (and *Pseudostenophylax*) by the characters separating these two subfamilies given by Flint (*op. cit.*).

Larvae from Corvallis, Oregon, in the collection of the Illinois Natural History Survey, identified as *Clostoeca disjuncta* (Banks), are very similar to the larvae of *Chyranda*. These larvae have been described under the name *C. disjuncta* by Flint (1960). Mature pupae of *C. disjuncta*, apparently associated with, although not in, pupal cases similar to those described here, are dated April 9, 1942. It is noteworthy that these pupae do not have sclerotized plates on the eighth abdominal segment as pupae of *Chyranda centralis* do. Larvae of *Chyranda centralis* and *Clostoeca disjuncta* might, then, be very similar, although the larval association of *C. disjuncta* appears not entirely clear and should be confirmed.

Larva (Figs. 8, 10, 11).—Head distinctly shortened, broad in relation to the length; central and anterior portions of the dorsum of the head flattened, the area delimited by a low ridge, and traversed by many small transverse corrugations. Head mainly shiny dark brown in colour; several of the dorsal hairs of the head long and very stout at the base. Ventral surface of the head dark brown, gula somewhat lighter.

Pronotum shiny dark brown, a row of dark hairs along the anterior margin, with a row of very fine clear hairs beneath these; hairs almost totally lacking from the area in front of the transverse depression, but with scattered hairs, mostly lateral, posterior to this depression; prosternal horn slightly longer than the front coxae, prosternal plate very lightly sclerotized. Mesonotum dark brown, a lighter patch at each posterolateral corner, just inside a very dark corner margin; a row of small sclerites on the sternum. Metanotum with the anterior sclerites (seta 1) broadly elliptical, the posterior sclerites (seta 2) ovoid, and the lateral sclerites (seta 3) narrow in front, broadened posteriorly; dorsal hairs confined to these sclerites. Legs typical for the subfamily Limnephilinae.

First abdominal segment with some 40 short, black hairs widely scattered over the dorsum, about the same number on the ventral surface, and in addition to these a ventromedian prominence, slightly sclerotized, with about 12 more hairs; dorsal and lateral humps moderately developed, the lateral humps lightly sclerotized around the base. Gills stout, arising singly, arranged as in Fig. 11. An oval sclerotized ring on the ventral surface of segments III to VII inclusive. Sclerite on the dorsum of segment IX medium brown, with 4 long hairs and 5 or 6 shorter hairs. No minute bifid processes dorsad of the lateral line. Anal claws each with one dorsal accessory tooth. Length of mature larva about 18 mm.

Pupa (Figs. 12, 13).—Unusual among other limnephilid pupae in having the sclerotized hook-bearing plates extending to the eighth abdominal segment, rather than the seventh. Differing from many other limnephilid pupae in the presence of 3 short black hairs on the basal segment of each antenna. The apex of each terminal process not clavate as in *Philarctus*.

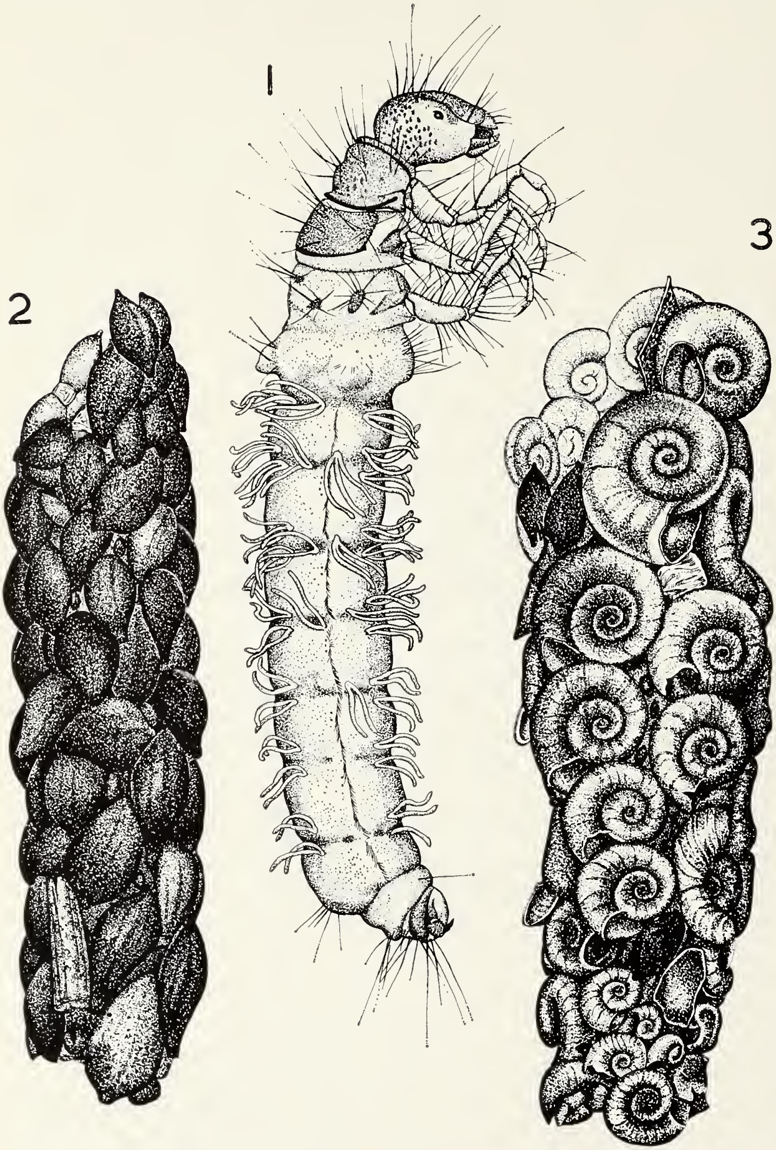
Case (Fig. 9).—Larval case composed of quadrate pieces of deciduous leaves and thin bark fastened together to form a tubular case with a prominent flange-like seam along each side; the case, in cross-section, broadly elliptical; terminal pieces at the posterior end generally fastened together around much of apical margins, leaving a small central opening. This is a very unusual type of larval case.

Pupal case apparently the same as the larval case, but with the posterior end cut off truncately and stopped with a silken sieve membrane, with relatively few open meshes; anterior end of the case closed with pieces of leaves fastened flatly together by means of a thin, sieve membrane between them.

Habitat.—Larvae of this species were found in several very small cold spring streams and runs in western Canada. Adult emergence dates indicated by the reared specimens listed below are probably unusually late because the larvae were held in ice from late June until the return to the laboratory on July 6. Adults probably emerge over much of July, as indicated by the Alberta records following.

Material Examined.—*Alberta:* Cypress Hills Prov. Pk., 4–29 July 1952, 4♂ 3♀ (Can. Nat. Coll., Saskatoon); Jasper Nat. Pk., Cottonwood Cr., nr. Jasper, 20 June 1962, 2 larvae, 1 reared emerging 7 Aug. 1962. *British Columbia:* Kootenay Nat. Pk., roadside springs on Hwy. 93 nr. Mt. Assiniboine, 23 June 1962, many larvae. *Saskatchewan:* Cypress Hills Prov. Pk., spring run entering Loch Leven, 27 June 1962, many larvae, 2 reared, emerging 30 July and 3 Aug. 1962.

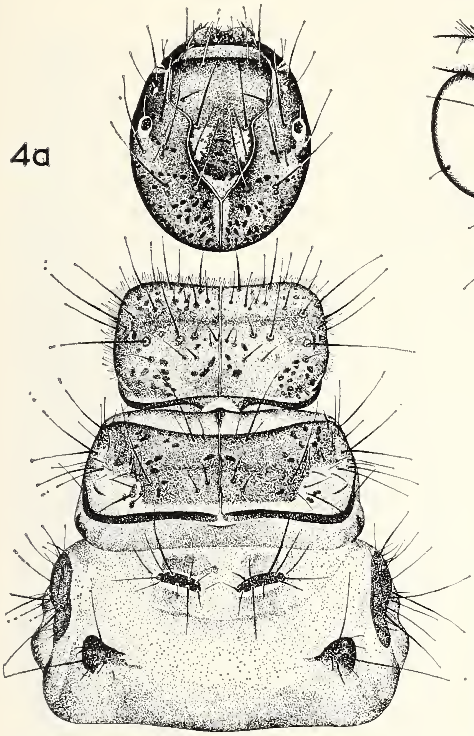
WIGGINS PLATE I



Philarctus quaeris (Milne). Fig. 1, Larva. Fig. 2, Larval case of seeds. Fig. 3, Larval case of snail shells.

WIGGINS PLATE II

4a



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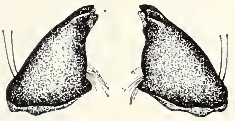

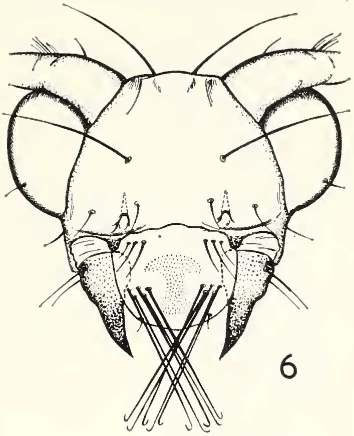

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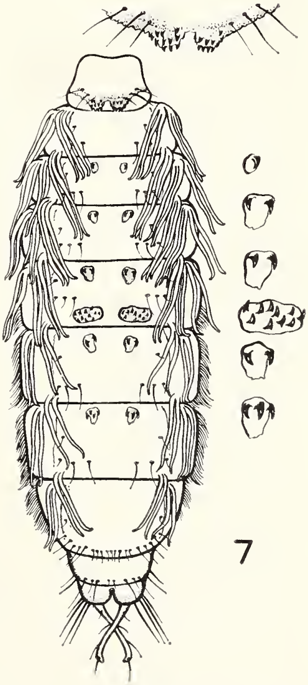

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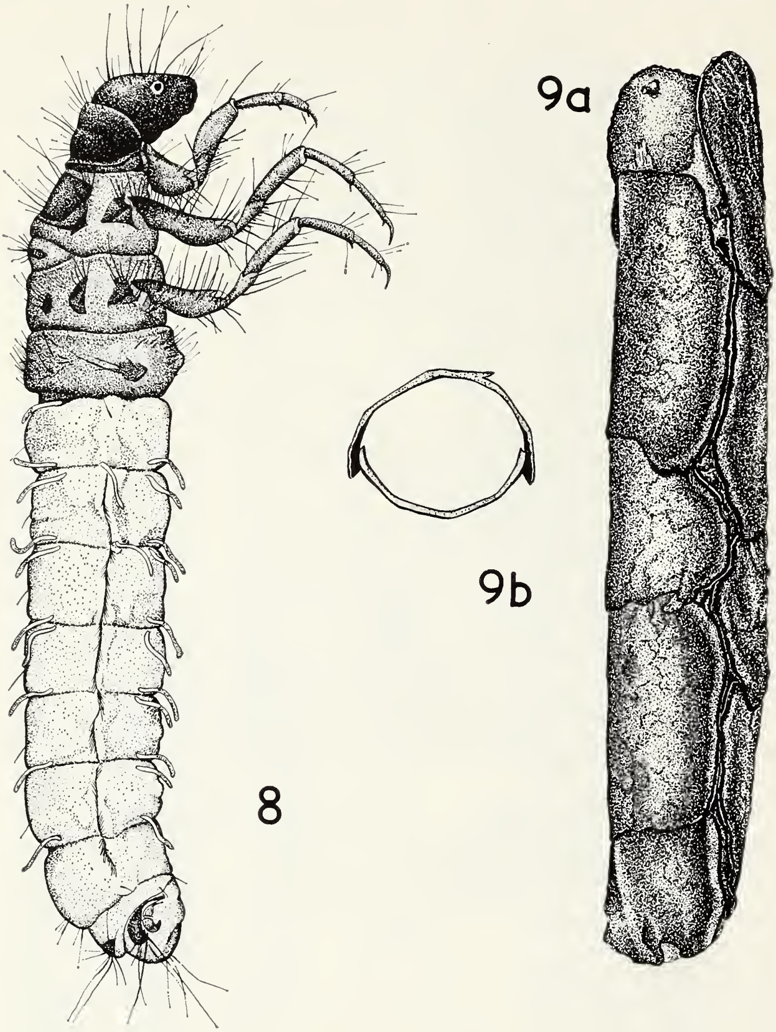
VIII		VII		VI		V		IV		III		II		I	
	2	2	2	2	2	2	2-3	2-3	3	3	3	3	3		
					0-1		1-2		2-3		3		3		
		0-1		0-1		1-2		1-2		3		3			
	1-2	2	2	2	2	2-3	2-3	3	3	3	3	3	3		

Philarctus quaeris (Milne). Fig. 4a, Larva, head and thorax. Fig. 4b, Larva, mandibles, dorsal view. Fig. 5, Larva, diagram of arrangement of gills. Fig. 6, Pupa, head. Fig. 7, Pupa, abdomen, with enlarged views of sclerites.

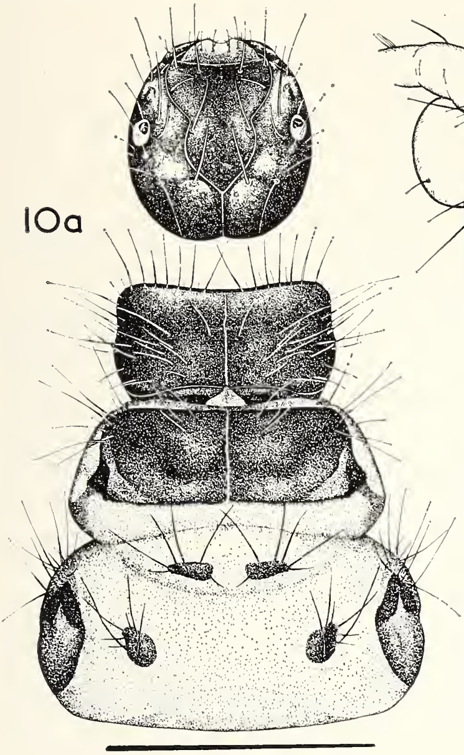
WIGGINS PLATE III



Chyranda centralis (Banks). Fig. 8, Larva. Fig. 9a, Larval case. Fig. 9b, Cross-section of case, dorsum uppermost.

WIGGINS PLATE IV

10a



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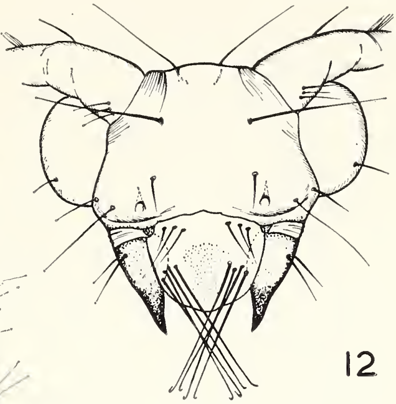

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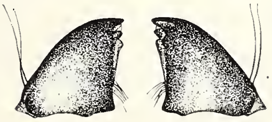

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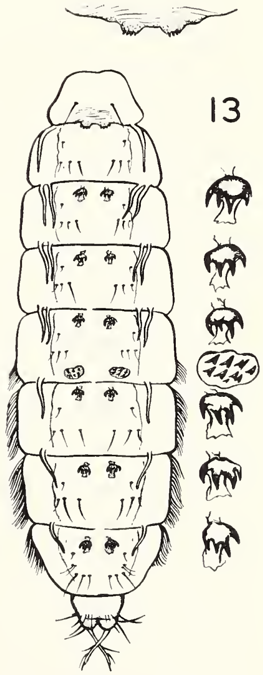

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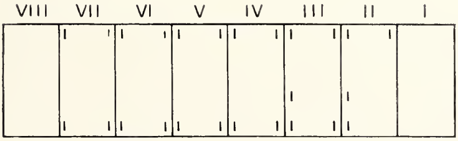

Chyranda centralis (Banks). Fig. 10a, Larva, head and thorax. Fig. 10b, Larva, mandibles, dorsal view. Fig. 11, Larva, diagram of arrangement of gills. Fig. 12, Pupa, head. Fig. 13, Pupa, abdomen, with enlarged views of sclerites.

ACKNOWLEDGMENTS

Support from the National Science Foundation (G22135) for the continuing project from which the present study is derived is acknowledged with appreciation. T. Yamamoto served as a student assistant during the summer of 1962. The figures were prepared by K. S. Pogany (larvae) and C. N. Storwick (pupae).

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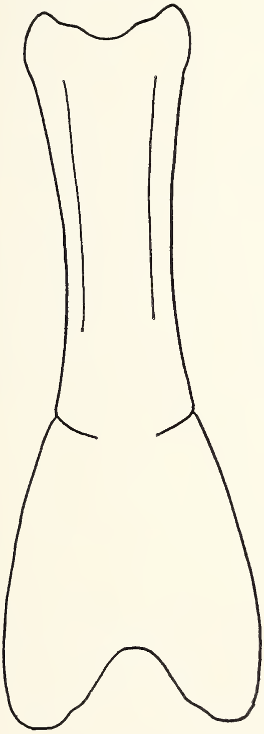
LECTOTYPE DESIGNATION FOR *RANATRA QUADRIDENTATA* STÅL (HEMIPTERA: NEPIDAE)

By Arnold S. Menke
University of California, Davis

Recently Dr. Eric Kjellander of the Stockholm Naturhistoriska Riksmuseet sent me the syntypes of *Ranatra quadridentata* Stål for study. Stål did not specify how many specimens he had before him at the time of his description. One male and three female specimens sent to me bear labels "Mexico," Sallé, and probably represent the original series studied by Stål. In addition, one of the females has a hand written label "4-dentata," Stål, and a red "typus" label, the latter obviously a recent addition. I am designating this specimen as lectotype.

The front femur and the anterior lobe of the pronotum are shorter and stouter in the syntypes of *quadridentata* in comparison with other material of this species from Mexico and the United States, indicating that further study is needed to ascertain the significance of this variation. Figure 1 illustrates the dorsal aspect of the pronotum of a female *quadridentata* from Del Rio, Texas and Figure 2 the pronotum of the lectotype. Figure 3 is a lateral view of the front femur, tibia and tarsus of the lectotype. The prominent tooth and semicircular notch near the apex of the femur are distinctive in this species.

Ranatra quadridentata is a common insect in southern Arizona and ranges westward to the Coachella and Imperial Valleys of California. This species also occurs in southern Texas and the central plateau region of Mexico.



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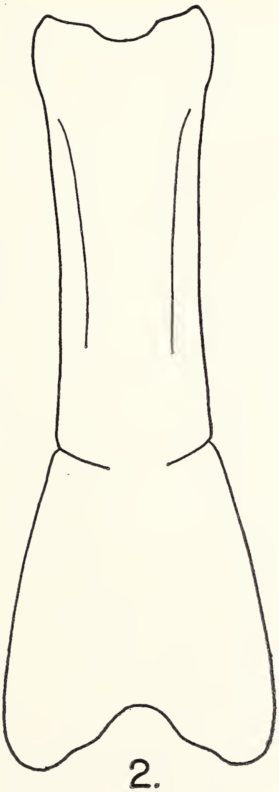

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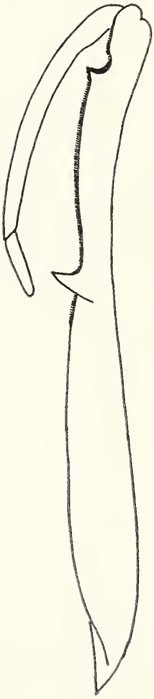

3.

LEPTOCORIS TRIVITTATUS (SAY) AND *CORIOMERIS HUMILIS* UHL. IN NEW ENGLAND (HEMIPTERA: COREIDAE)

By James A. Slater[1] and Carl W. Schaefer[2]

In the present paper we have attempted to bring together existing records of the Box Elder Bug in New England and to report the occurrence of another coreid hitherto unknown east of the Mississippi River.[3]

Leptocoris trivittatus (Say)

The Box Elder Bug is a well known pest in the western and midwestern United States. It breeds upon the Box Elder tree or Ash-leaved maple (*Acer negundo* L.) and often becomes a distinct nuisance in towns and farmyards, particularly in the fall of the year when the adults leave the trees to hibernate on or within houses.

Although apparently originally a western species, the insect has been extending its range eastward for many years. There have been reports in the economic literature for a considerable period from New York and the middle Atlantic states, but it has not been thought to be present in New England. (McAtee (1926) noted its eastward trend and arrival in the District of Columbia).

L. trivittatus came to our attention several years ago when it was reported in outbreak numbers from several Connecticut localities. Since the species is not recorded from New England in any of the comprehensive hemipterological works (Van Duzee 1917, Parshley 1923, Blatchley 1926, Torre Bueno 1941), we have attempted by a review of the often ephemeral economic literature and by correspondence to ascertain when the bug entered New England and its current status in the area.

The Box Elder Bug became established in New England in the 1940's although the first literature records occur almost simultaneously in 1953 and 1954. (Coop. Econ. Ins. *Rpt. 3*:294—New Hampshire (1953); *4*:12—Massachusetts: *4*:95—Rhode Island (1954).)

The earliest authenticated specimens we have been able to discover are from Storrs, Ct., in 1940 (Parshley Coll., Calif. Acad.

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[1] Department of Zoology and Entomology, University of Connecticut, Storrs, Connecticut.

[2] Department of Biology, Brooklyn College, Brooklyn 10, N. Y.

[3] Torre-Bueno (1921) records *Coriomeris humilis* (Uhler) from St. Petersburg, Fla. and this distribution is followed by Blatchley (1926). However, Torre-Bueno (1941) does not include Florida in the distribution. Until the original material can be examined this must remain a questionable record.

Sci.); and Amherst, Mass., in 1942 (U. Mass. coll.). There are specimens from Willimantic, Conn. taken in Oct. 1949 (U. Conn. coll.); from Providence, R. I., in Sept. 1953 (U.R. Is. coll.); and from Amherst, Mass. in 1953 (U. Mass. coll.).

In the U. of Massachusetts collection are two specimens taken in October, 1923, and bearing the label "Springfield." One infers that this is Springfield, Massachusetts, but the ambiguity of the label and the 19 years between this and the next available record makes it suspect. However, it is quite possible that the species was present in New England in very small numbers at that time. In any event the Box Elder Bug first appears as a pest species in houses at the end of the 1940's and in the early 1950's. Since 1953 it has been reported three additional times in the literature (Coop. Econ. Ins. Rpt. (1957) *7*:933 and (1961) 9:390—Rhode Island; (1958) *8*:327—Connecticut). We have also obtained the following records subsequent to 1954:

Connecticut: Storrs 1955, Willimantic 1956 (U. Conn.); Windsor 1957, 1958, 1960, South Windsor 1959, New Milford 1959, Plainfield 1961 (Conn. Agr. Expt. Sta. "blue book").

Massachusetts: Springfield 1958. (Conn. Agr. Expt. Sta.)

Rhode Island: Kingston 1955, W. Warwick 1958 (U. Rhode Is.)

New Hampshire: Manchester 1955, 1957, 1961. (U. N. Hamp.)

Interestingly the Box Elder Bug has not yet been reported from Vermont and Maine although we have received information from the U. of Maine and the U. of Vermont collections.

The irregular and widely separated locality data are almost certainly not fortuitous and reflect only in part the location of collectors and academic institutions. Most of the reports have come from economic workers in reply to requests for aid when the insect has become a nuisance. The scattered records probably reflect the distributional picture of an animal at the periphery of its range or where it is extending the limits of its range. In the case of *Leptocoris trivittatus* this irregular distributional picture is accentuated by its marked host specificity. Despite occasional feeding by the adults upon fruits, ornamentals, etc., the Box Elder Bug is normally restricted as a breeding species to *Acer negundo.* This rapidly growing tree is rare as a native species east of the Alleghenies but has been planted in a number of towns throughout the northeast and many of the trees have attained maturity. We have no evidence of the outbreak of the species except where there is an association with the host tree.

In addition to the New England records cited above the United States National Museum possesses specimens from the following states, many of which have not previously been reported in the literature:

Arizona
Colorado
District of Columbia
Florida
Illinois
Iowa
Kansas
Maryland
Minnesota
Missouri
Montana
Nebraska
New Jersey
New Mexico
New York
North Dakota
Oklahoma
Pennsylvania
South Dakota
Tennessee
Texas
Utah
Virginia
West Virginia
Wisconsin
Saskatchewan
Alberta (Froeschner coll.)

The attempt to trace the spread of this conspicuous and brightly colored insect has brought home to us the deplorable decline in the study of local faunas in the past decades. Granting the abuses and provincialisms that such studies have often exhibited in the past, they remain the only practical means by which really detailed knowledge can be obtained for analysis of expansions and contractions of ranges and to delineate the faunal composition as it reflects changing environmental and ecological conditions. The entomologist cannot but be envious of the data available to the ornithologist when the latter attempts to document the spread in New England of such birds as the Cardinal and the Tufted Titmouse.

Coriomeris humilis (Uhler)

This coreid was described by Uhler (1872) from Calif., Colo., and Kans.; and it was reported by Blatchley (1926) and Torre Bueno (1946) from Calif. to Kans. and north to Brit. Col.

In May, 1960, a single male specimen was collected by a student (R. Darrow) in an introductory entomology course, from Storrs, Connecticut (J. A. Slater coll.). This may represent a fortuitous individual far east of its range. However, the distribution is not so exclusively western as the literature would indicate. The U. of Michigan museum collection possesses specimens from Lucas Co., Ohio and seven counties in Michigan (Marquette, Oakland, Washtenaw, Otsego, Saginaw, Crawford and Cheboygan). In addition, the Calif. Acad. Sci. possesses a single specimen from Berrien County. These Michigan records (four from northern counties) are of considerable interest, as are additional ones from southern Canada. Three specimens in the Entomology Research Institute of the Canada Department of Agriculture were collected from Wellington (1916) and Pt. Pelee (1931), Ontario; and Moore (1950) records it from St. Thomas de Joliette, Quebec.

There is a definite although poorly understood hemipterous fauna that is predominantly western but extends far eastward in the northern tier of states and in southern Canada (the mirid

Labops hirtus Knight is another example (see Slater, 1954)). The occurrence of *C. humilis* in Connecticut may therefore represent an extreme eastern point in a range across the northern states rather than merely a stray individual.

ACKNOWLEDGMENTS

We wish to express our appreciation to the following individuals for sending information on material present in their respective institutions: R. T. Bell (U. Vermont), J. G. Conklin (U. New Hampshire), R. C. Froeschner (U.S. National Museum), Leonora K. Gloyd (Illinois Nat. Hist. Survey), K. E. Hyland (U. Rhode Island), L. A. Kelton (Entomology Research Inst., Canada Dept. Agric.), J. N. Knull (Ohio State U.), J. B. Kring and D. E. Leonard (Conn. Agric. Exper. Station), T. E. Moore (U. Michigan), C. V. Reichart (Providence College), J. C. Schaffner (Iowa State U.), G. W. Simpson (U. Maine), M. E. Smith (U. Massachusetts). In addition, Mr. P. D. Ashlock (U. Calif., Berkeley) kindly checked the Parshley Collection at the Calif. Acad. Sci.

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MISCELLANEOUS PREY RECORDS OF SOLITARY WASPS. V. (HYMENOPTERA: ACULEATA)[1]

By Karl V. Krombein[2]

In the present contribution I am reporting some miscellaneous prey records and other biological observations made during 1960–1962 on solitary predaceous wasps of the families Pompilidae and Sphecidae at Plummers Island, Maryland, and in Arlington, Virginia. I am indebted to the following specialists for identifications of the prey or parasites of the wasps: My colleagues R. H. Foote, J. P. Kramer, C. W. Sabrosky and D. M. Weisman for Diptera, Hemiptera and Coleoptera; W. J. Gertsch and W. Ivie, American Museum of Natural History, for Araneae; and W. L. Downes, Jr., University of Illinois, for Diptera.

Family Pompilidae

Episyron q. quinquenotatus (Say)

Two females of this wasp were taken with their prey on sandy beaches on Plummers Island. One of the wasps (73061 A), 8 mm. long, was captured at 1530 on July 30, 1961. She was taken on a low bush with a paralyzed, immature araneid spider, *Araneus* sp., 4.5 mm. long. The second wasp (72162 A), 9 mm. long, was captured at 1645 on July 21, 1962, just after she had left her paralyzed araneid prey on a small cottonwood leaf 23 cm. above the ground. This spider was an immature male of *Neoscona arabesca* (Walck.), 6 mm. long. I watched a third female (72162 D) excavate a shallow burrow in the same locality at 1715 on July 21, 1962. She abandoned this project, and presumably dug another burrow elsewhere.

Family Sphecidae

Podium luctuosum Smith

I watched a female of this species sealing her nest entrance with mud at Plummers Island on July 17, 1961. The nest was in a boring in a large, dead, standing, barked tree with sound wood, in dense shade just a few meters above the Potomac River. Several weeks later I chiseled out this nest and obtained a mature larva which was preserved for taxonomic study. On July 21, 1962, I watched another female (72162 E) near the cabin from 2000 to 2020. She was gathering mud near the outdoor fireplace and then flying off high into the air. Presumably her nest was in a dead, standing linden nearby, because the wasp returned at frequent intervals for more mud. That the wasp was working into the late dusk is remarkable.

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[1] The preceding number in this series was published in Bul. Brooklyn Ent. Soc. 56: 62–65, 1961.

[2] Entomology Research Division, Agricultural Research Service, U. S. Department of Agriculture, Washington, D. C.

Gorytes (*G.*) *canaliculatus* Packard

A small population of this species nests in coarse sand at the upper end of Plummers Island. On July 17, 1961, at 1400 I captured a female, 8.5 mm. long, hovering low over the sand with her paralyzed leafhopper prey. The latter was a pale-green, adult female cicadellid, *Macropsis viridis* (Fitch), 5.3 mm. long. On June 9, 1962, I dug up a nest of this wasp (6962 A) in the same area. The burrow was on a slight slope and nearly 5 mm. in diameter. It went in at an angle of 10° to the horizontal for nearly 4 cm., then turned at right angles and went downward at an angle of 45° for another 10 cm. The cell was in moist sand nearly 13 cm. below the surface. It held a dozen, mostly fifth-instar, cicadellid nymphs, 4.5–6.0 mm. long, of a species of *Idiocerus*. There was no wasp egg, so presumably the cell was not completely stored. I did not capture the wasp. I dug up a second incomplete burrow (6962 B) on the same date. It also had a diameter of nearly 5 mm., went in at a 20° angle, and ended about 3 cm. from the entrance.

Cerceris insolita Cresson

This species also nests in the coarse sand on the beach at the upper end of Plummers Island. I captured a female (72261 A), 9 mm. long, at 1430 on July 22, 1961. She was hovering in the air just above her burrow entrance near a small plant, and was carrying her paralyzed beetle prey. The latter was a dark-green chrysomelid, *Rhabdopterus praetextus* (Say), 5 mm. long. I did not excavate the burrow.

Crossocerus (*C.*) *planipes* (Fox)

I found two nests of this species at Plummers Island, both in partially shaded, bare soil. The first female (6461 A), 5.8 mm. long, was caught as she left her burrow near the picnic table at 1500 on June 4, 1961. The burrow went downward at a shallow angle of 20°–30°, had two angulations, and ended in a cell about 3 cm. below the surface. This cell was only partially stored; it contained five empidid flies, *Drapetis* sp., 2–2.5 mm. long. A second cell, to one side and about a centimeter nearer the surface, contained 16 flies of the same species and a wasp egg. Both cells were ovoid and about 6 mm. long. I captured the second female (52662 A), 5.2

mm. long, on May 26, 1962, as she left her burrow in a sloping woodland path. The entrance had a diameter of about 3 mm., and was surrounded by a low tumulus of fine grains of excavated soil about 25 mm. long and 15 mm. wide. Most of this spoil heap was on the downhill side of the entrance; it was about 8 mm. high to the left of the entrance, but most of it was only 1–3 mm. high. The burrow went downward at a shallow angle for about 3 cm. to a depth of 0.8 cm., then turned downward at an angle of about 60° to a point 2 cm. below the surface. I found a cell about 2 cm. from the lower end of this burrow at a depth of about 2.5 cm. Although there was no visible connection between the cell and the end of the burrow, the cell in all probability had been completely stored by this wasp and the part of the burrow leading to it solidly filled in. There were no other burrows in this section of the path. The cell contained 13 paralyzed empidid flies, *Chersodromia* sp., 2.5 mm. long. I did not recover a wasp egg, but it may have been knocked off unnoticed when I removed the flies from the cell.

Ectemnius (*Hypocrabro*) *continuus* (Fabricius)

I found a nest (11760 A) of this crabronine wasp in a rotten pear limb near my home in Arlington on November 7, 1960. It consisted of several burrows with cells separated from each other by 10–20 mm. of tightly packed bits of rotten wood. Altogether there were seven or eight cells in the section of limb which I recovered. Four of the cells contained crabronine cocoons, 11–13 mm. long, and a fifth cell contained the large puparium of a dipterous parasite. In the other two or three cells the wasps failed to develop, and only the dipterous prey remained. The dipterous prey from these cells was identified as follows: Calliphoridae, 5 *Pollenia rudis* (F.) and 2 *Phaenicia* (?) sp.; Tachinidae, 1 *Winthemia* sp.; Sarcophagidae, 1 *Sarcophaga* sens. lat.; and Muscidae, 1 specimen, genus and species unidentifiable. The live material, except for one wasp larva preserved for taxonomic study, was kept outside from November 14, 1960, to March 24, 1961. A female of *continuus* emerged from one of the cocoons on April 5. On April 7 a male of *Macronychia aurata* (Coq.) emerged from the dipterous puparium. This is the first host record for an American *Macronychia;* some of the European species have also been reared from crabronine wasps.

Oxybelus emarginatus Say

I captured a female (6962 C), 4.7 mm. long, with her prey on coarse sand at Plummers Island at 1235 on June 9, 1962. The prey was a male dolichopodid fly, *Gymnopternus* sp., 3.5 mm. long.

OBSERVATIONS OF SUSPECTED DENSITY DEPENDENT FIGHTING BETWEEN FEMALES OF THE CICADA KILLER WASP SPHECIUS SPECIOSUS

By Norman Lin[1]

Fighting between females of the cicada killer wasp, *Sphecius speciosus* (Drury), is virtually unknown, there being only one published account of fighting, and that differed from the kind discussed in this paper. On August 2, 1961, in the Parade Grounds, a sandlot ball field in Brooklyn, New York, a female cicada killer climbing a fence while holding prey (in order to get enough altitude for a successful flight to her nest) was suddenly pounced upon by another female in flight which then fought with her. The cicada dropped to the ground and about a second later both females, locked in wrestling, also fell to the ground where they continued to wrestle and buzz loudly. A small cage (approximately three inches by six inches) was placed over them after about five minutes of fighting and they continued to wrestle for about five minutes more in the cage. They then ceased fighting and showed no apparent interest in each other, even though they were next to one another much of the time because of the small size of their quarters. They were kept together under similar conditions of crowding for a week with no observed change in their behavior.

On August 20, 1961, a female cicada killer was noted on the sparsely vegetated ground adjacent to the same fence. Another female carrying a cicada was on the ground about two feet away, and still a third female landed about six inches from the first. These two met, grasped each other, and wrestled for a few seconds. They then separated and disappeared, presumably down one or two of the several nest burrows in the immediate vicinity.

The female carrying the cicada was frightened from the area a number of times by passing people. She returned each time to pick up the cicada. On one occasion, she landed several feet away, and only a few inches from another female. The two females met and wrestled for a few seconds.

These aggressive situations involving fighting pairs of females were rare, at least in the vicinity of the four major Parade Ground colonies. Studies of these colonies, which are located on approximately equal sized sandy footpaths along opposite sides of two adjacent baseball fields, have been in progress for the last six years

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[1] Department of Zoology, The University of Kansas.

(1956–61), and most intensively for the last four years. This type of aggressive activity was observed three times and only during the 1961 season. Females, however, have occasionally directed seemingly aggressive flights at other females (without prey) and males in flight (Lin, 1963). Another type of fighting is food induced and will be discussed in a later paper.

The factors responsible for the aggressive activity described above are unknown. There is, however, some evidence that such fighting is associated with high population density. The colony in which the fighting occurred had, in 1961, a larger population size and density than other colonies during the period of study, with the possible exception of 1956, when only a relatively insignificant amount of data was obtained. This colony's population size and seemingly its density were almost four times as great as its previous high in 1960, and almost four times as great as the second largest colony studied.

The total amount of time spent in observing the wasps from 1956–61 was considerably greater than that amount spent in the largest colony in 1961, and the total number of wasps for all these seasons was more than 2½ times greater than the number in the largest colony in 1961. Consequently, these observations of fighting were not associated with a greater amount of observation time nor with a larger number of observed wasps.

The fighting observed on August 20 also lends support to the view that the fighting is density dependent. There were three or four female wasps on the ground in a small area, and pairs only inches apart met and fought on two occasions. In preceding seasons there were no observations of two or more females so close together on the ground. The occurrence of chance meetings as a result of high density cannot be the entire explanation for the fights, however, since females kept in confined quarters in captivity continually encounter each other without fighting.

The observation made on August 2 might also in part be a consequence of high density though this is not nearly as evident. This situation differs from the other two in the following ways:

1. A female in flight pounced directly on another female.
2. The female which was pounced upon was carrying a cicada.
3. The fighting lasted considerably longer.

While the two fights observed on August 20 seemed to involve chance meetings, this almost definitely was not the case on August 2 when a female apparently "deliberately" pounced on another. Because the latter female was carrying a cicada, there is some reason to suspect that the cicada was wholly or partly responsible for triggering the attack.

Such fighting between nesting females is possibly a mechanism for regulating population size possibly by causing emigration or affecting reproduction.

REFERENCE

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THREE STONEFLIES (PLECOPTERA) FROM CAPE THOMPSON, ALASKA[1]

By STANLEY G. JEWETT, JR.[2]

Among the large collections of invertebrates secured during 1959, 1960 and 1961 by General Electric Company biologists assigned to Project Chariot[3] near Cape Thompson, Alaska, are several score stonefly nymphs and adults. These were sent to me for identification[4] and include the three species recorded below.

The streams where the specimens were collected are situated in an arctic tundra environment. Collecting sites on Ogotoruk Creek are about nine miles inland from the coast, and on the Kukpuk River, about fifteen miles inland northeast from the mouth of Ogotoruk Creek. Keeseemalowk Creek runs parallel to Ogotoruk Creek and enters the sea about four miles southeast of Ogotoruk Creek.

Specimens are deposited in the collections of the United States

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[1] Supported by NSF Grant G12858, National Science Foundation.

[2] 7742 S.E. 27th Avenue, Portland 2, Oregon.

[3] A proposal of the United States Atomic Energy Commission's Plowshare Program which involves testing nuclear explosives for harbor and channel excavation. The project site is at the mouth of Ogotoruk Creek (Weichold, 1962).

[4] I am grateful to Jared J. Davis, formerly of Hanford Laboratories of General Electric Company, for sending the material to me for study.

National Museum (USNM), California Academy of Sciences (CAS), Hanford Laboratories (HL), and the writer (SGJ).

Nemoura arctica Esben-Petersen

Ricker (1952, p. 36) records this species from Alaska to Hudson Bay, south to Churchill, Manitoba.

Judging from abundant nymphal material this species is common in Ogotoruk Creek. Wings of the adults vary in length but none extends less than to the end of the abdomen. Wings of some of the female specimens are fully developed.

The material contains many score nymphs of various sizes and the following adult specimens from Ogotoruk Creek and adjacent headwater ponds: 1♂ 2 ♀♀, 21 June, 1960, D. G. Watson (SGJ); 1 ♂ 1 ♀, 28 June, 1960, W. C. Hanson (HL); 2 ♀♀, 29 June, 1960, D. G. Watson (USNM); 1 ♀, 30 June, 1961, J. J. Davis (USNM); 2 ♂♂ 2 ♀♀, 25 June, 1960, D. J. Watson (CAS, SGJ).

Capnia ogotoruka, n. sp.

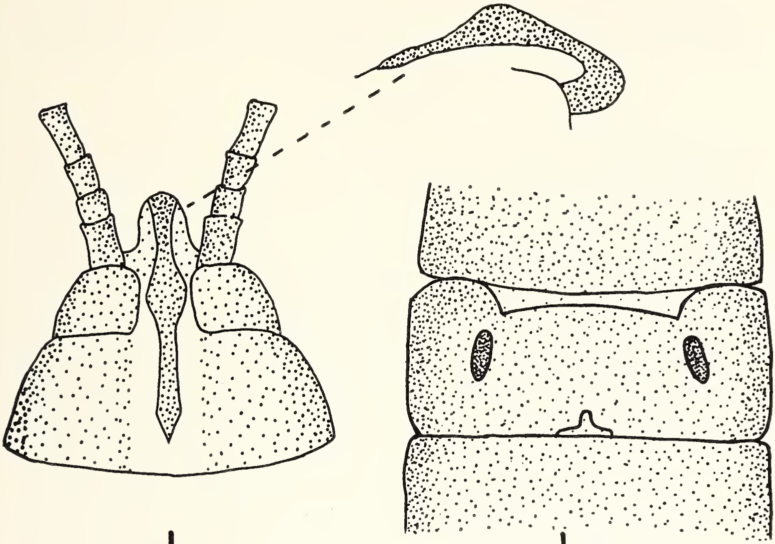
Coloration and structural details typical for genus.

Male.—Length of body, 6.5–7.5 mm., wings, 8–10 mm. Body and appendages heavily sclerotized, dark brown on upper surfaces, lighter below. First 9 abdominal segments without special modification; 9th sternite without a lobe; no prominent humps or knobs on any tergites, low humps on 9th; light, medium, narrow stripe across first 9 tergites. Supra-anal process, Figure 1, reflexed, reaching nearly across tergite 9, slightly thickened midway in its length in both dorsal and lateral view, the tip with sharp median projection.

Female.—Similar in general features to the male but somewhat larger. Subgenital plate recessed, Figure 1A, with a broadly-rounded apical portion. There is a pair of large, oval, darkly-pigmented areas on the sternite at either side of the plate.

Types.—*Holotype* male and one *paratype* male, Ogotoruk Creek (Upper Station), Cape Thompson, Alaska, 28 July, 1960, W.C. Hanson (USNM). *Allotype* female, Ogotoruk Creek (Pond 4), Cape Thompson, Alaska, 20 Sept., 1961, R. Adee (USNM). Additional *paratypes* as follows: Mouths of Ogotoruk and Keeseemalowk Creeks, 2 ♂♂ 2 ♀♀, 1 August, 1961, J. J. Davis (HL & SGJ); Upper Station, Ogotoruk Creek, male, 30 June, 1961, J. J. Davis (SGJ); Ogotoruk Creek, 2 ♂♂, 6 Aug., 1961 (CAS).

Discussion.—This species is near *C. projecta* Frison and *C. oenone* Neave, differing from both principally in the shape of the



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1A

male supra-anal process. It goes to *C. oenone* Neave in couplet 24 in my key to the males of *Capnia* found in the Pacific Northwest (1959, p. 43) but differs from that species in being slightly smaller and in having a differently shaped supra-anal process, particularly in dorsal view.

Arcynopteryx compacta MacLachlan

A single female specimen of this northern species was taken along the shore of the Kukpuk River, June 23, 1961, by W. C. Hanson (USNM). The species is transcontinental in the arctic region (Ricker, 1952, p. 70.

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TECHNIQUES FOR DETERMINING THORACIC SCALE PATTERNS ON ALCOHOL-PRESERVED MOSQUITOES[1]

By Robert G. Means, Amherst, Mass.

Occasionally, as with the author's study of host preferences, adult mosquitoes must be preserved in alcohol for future determination. Since the identification of many species depends upon the thoracic scale patterns, and since the scales are pale and therefore extremely difficult to see in alcohol-preserved specimens, it was important to devise a technique for making the scales more readily visible.

Various stains and dyes were tried in an attempt to gain color contrast between the scales and the light thoracic background. For the author's specimens of *Culex* and *Aedes* preserved in 80% ethyl alcohol the following methods achieved the desired results:

1. The scales could be seen more easily and more accurately when the alcohol was replaced with malachite green stain in a 5 ppm absolute alcohol solution just prior to examination.
2. Even better results were obtained if the specimens were stained with safranin 0 (5% aqueous) for 12–18 hours, then rinsed with water and placed in the malachite green solution.

In both cases described above, the malachite green serves only as a contrasting background and does not stain the specimens. The safranin 0 colors the internal organs and parts of the exoskeleton a deep red but tends not to affect the scales. The red-stained thorax and the green-blue alcohol serve very effectively to define the scale patterns.

It should be noted that overstaining may make the scales pinkish and more difficult to see than not staining at all. Also, staining does cause some other taxonomically important parts to be less easily seen, for example, banding of legs and palps and coloring of wing scales. Therefore, the staining method should be applied only when a study of thoracic or abdominal scale patterns is necessary for identification. To reduce chances of losing scales, it is best to decant and replace the liquids rather than to transfer the specimens from one liquid to another.

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[1] Contribution No. 1364 from the entomological laboratories of The University of Massachusetts. Part of a project on host preferences of mosquitoes, supported by New York State Museum and Science Service.

A NEW PARASIMULIUM AND FURTHER RECORDS FOR THE TYPE SPECIES (DIPTERA: SIMULIIDAE)

By Alan Stone[1]

The genus *Parasimulium* Malloch has, until recently, been known from a single male only. Recently more specimens of the type-species, *P. furcatum* Malloch, have been brought to light and a single, headless male of a second species has been found. It is unfortunate that the head of the type of the new species is missing, since some of the most interesting features of the genus lie in the head. However, I am describing the species in spite of its mutilation because of the great interest the genus has aroused among simuliidologists. I hope this note will stimulate further search for the females and immature stages so that the correct position of the genus within the family can be established.

Parasimulium melanderi, n. sp.

Almost black species, the wings somewhat milky white. Head missing. Scutum brownish black, subshining, with appressed brown hair. Setae on thorax dark, those on pronotum long and curved, on propleuron shorter and straighter, a proclinate group anterior to scutellum, and an irregular row of long curved ones on margin of scutellum. Rest of thorax bare. Halter dark. Wing 2.2 mm. long. Costa, subcosta, and radius yellowish brown, the other veins very weak and pale. Venation as in Fig. 1. Stem vein with long dark setae. All strong veins with rather long, slender hairs, particularly dorsally. No trace of basal cell; submedian fork scarcely indicated. Legs nearly black, with concolorous hair. Femora and tibiae somewhat flattened. First hind tarsomere about four times as long as wide, scarcely narrowed at ends. Ratio of hind tarsomeres 1 to 3 as 9: 4: 2. Abdomen dark, the basal fringe very long, dark brown. Terminalia with ventral plate as figured (Figs. 3, 4); paramere as figured (Fig. 2) the distimere slightly longer than basimere, flat, rounded distally, with no tooth.

Holotype: Male, Nooksack River, Mt. Baker, Washington, 11 Aug. 1925, A. L. Melander (U. S. National Museum).

This species can be readily distinguished from *furcatum* by its entirely dark colors in contrast to *furcatum* with yellow basal abdominal segments and legs. As A. L. Melander has collected seven of the eight known specimens of *Parasimulium*, it is appropriate that this new species be named in his honor.

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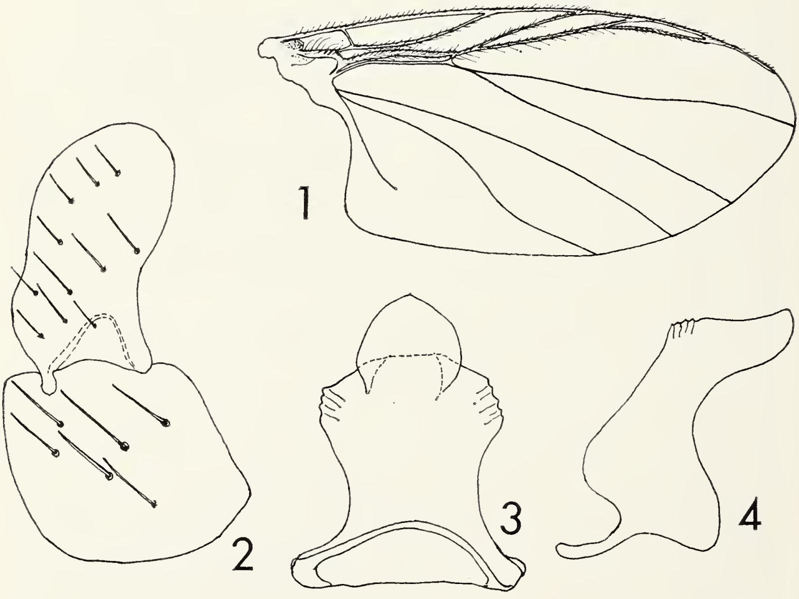
[1] Entomology Research Division, Agric. Res. Serv., U. S. Department of Agriculture, Washington, D. C.

Parasimulium furcatum Malloch

A short note was published on the discovery of a second locality for this species (Stone, Proc. Ent. Soc. Washington 64: 174, 1962). Further search through the Melander collection revealed four more specimens, bringing the total number to seven. All were males and nothing that could possibly be the female of this species was discovered. The collection data for the entire series are as follows, all but the holotype having been collected by Melander, and each locality (except Viento) represented by one specimen only.

California: Bair's Ranch, Redwood Creek, Humboldt Co., H. S. Barber (holotype). Bolling Park, 19 June 1935: This locality is not certain but is probably Bolling Grove in the Humboldt Redwoods area, Humboldt County. *Oregon:* Eagle Creek, Hood River County, 15 June 1925: According to Mrs. Melander this specimen came from Eagle Creek Park near Bonneville and not from the Eagle Creek east of Oregon City in Clackamas County. Corvallis, Benton County, 21 June 1925. Benson Park, Multnomah County, 24 June 1935: Southwest of Bonneville, Viento, Hood River County, 1 July 1917.



Figs. 1–4, *Parasimulium melanderi,* n. sp. 1, Wing. 2, Paramere, ventral view. 3, Ventral plate, ventral view. 4, ventral plate, lateral view.

It is of interest to note that four of the specimens were collected along the north border of Oregon in three different years and that all of the known collecting dates are between June 15 and July 1. These dates contrast with the August 11 date for *P. melanderi.*

Parasimulium melanderi does possess certain characters in common with the type species not particularly noted in previous descriptions of the genus, as follows: The meso- and metapleuron entirely without hairs or scales; no basal cell in the wing; submedian fork very indistinct or absent; no spine at tip of distimere. I hope that an additional characteristic is not that females and immatures are immune to capture by man.

A NEW PANAMANIAN STINK BUG (HETEROPTERA; PENTATOMIDAE, DISCOCEPHALINAE)

By Herbert Ruckes[1]

In the course of field work conducted during 1962 in Panama and Costa Rica numerous interesting Heteroptera were captured. Among these was an outstanding pentatomid procured in the highlands of the state of Chiriqui, Panama. Unfortunately only a single female specimen was taken, but that one is so distinctive that it merits a new generic and specific name. It was collected while sweeping herbaceous vegetation on a previously burned-over jungle area, and at the time no notes were made concerning its food preferences.

Selenochilus, gen. n.

Closely related to *Oncodochilus Fieber,* subgenus *Oncoeochilus* Breddin.

Ovate, depressed above, moderately convex beneath. Head and anterior two-thirds of pronotum declivous.

Head longer than wide between the eyes; lateral margins without an anteocular spinous process, the region there merely

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[1] Research Associate, Department of Entomology, the American Museum of Natural History, and Professor Emeritus, the City University of New York. This study was supported in part by National Science Foundation grant G-9830.

thickened, then convexly arcuate, subparallel without distinct ampliation; juga longer than tylus, slightly incurved but not contiguous, leaving a distinct apical sinus; ocelli three times as far apart as distant from the eyes; tylus slightly swollen at its middle but not distinctly umbonate there. Antennae reaching the middle of scutellum, segment II shorter than I and about half the length of III.

Pronotum subhexagonal, posterolateral margins short, about one-third length of anterolateral margins; anterior margin very slightly wider than head through the eyes, centrally concave-arcuate, then obliquely truncate laterally, no intramarginal groove or furrow present; anterolateral margins entire, essentially straight, thinly carinate, distinctly reflexed. Scutellum subtriangular, about twice as long as wide at its base, frena ending well past the middle, postfrenal portion distinctly shorter than prefrenal part, the margins converging to a somewhat narrowly rounded apex. Hemelytral membranes slightly exceeding abdominal apex, veins few and simple. Connexival angles not produced.

Bucculae prominent, strongly elevated, triangular in lateral aspect, slightly divergent posteriorly. Labrum proportionately large, very much compressed, distinctly lunate in silhouette (hence *Selenochilus*) from the lateral aspect, its free (ventral) margin forming about two-thirds the arc of a circle, its surface transversely rugulose. Rostrum arising in line with antennal tubercles and eyes, surpassing the metacoxae, segment I exceeding the bucculae but not attaining middle of prosternum, segments II, III, and IV subequal. Mesosternum with a broad, low, subcalloused median ridge. Metasternum broadly hexagonal, tumid, its posterior surface weakly impressed. Mesocoxae and metacoxae farther apart from themselves transversely than they are distant from one another longitudinally. Posterior tibiae weakly curved, tarsi two-segmented. Pairs of trichobothria lying laterad of an imaginary longitudinal line joining the row of spiracles.

Female genital plates apparently five in number, the basal ones triangular, a little wider than long, the median one subtrapezoidal, the apical ones elliptical, widely separated from one another and convergent posteriorly.

Type Species—Selenochilus nitidus, new genus, new species.

Notes.—This genus differs from *Oncodochilus,* and the subgenus *Oncoeochilus* by the reflexed lateral margins of the pronotum, reduction of anteocular spinous processes to mere thickened margins, more widely spaced ocelli, longer frena and more narrowly rounded scutellar apex, slightly curved posterior tibiae, longer hemelytral membranes with simple veins, and five plates in the female genitalia.

Relationship to *Oncoeochilus* is shown by the apically incised head, presence of a broad subcalloused median ridge on the mesosternum, and tarsi composed of two segments.

Fieber put his genus *Oncodochilus* in the family Sciocoridae along with *Dryptocephala, Discocephala,* and several other Old World genera. Stål transferred the three genera mentioned above to the Discocephalinae as a subfamily of the Cimicidae (= Pentatomidae). Later, Kirkaldy reduced the Discocephalinae to tribal status, but retained the phyletic relationship of these genera. That *Dryptocephala* and *Discocephala* are true discocephalines is beyond question. Certain characters evident in *Oncodochilus* and the new genus *Selenochilus* make me question their close affiliation with *Dryptocephala* and *Discocephala;* certain aspects of them tend to make me believe that they are intermediate genera between the Discocephalinae on the one hand and the tribe Halyini of the Pentatominae on the other, and may be more closely allied to the Halyini. For the time being I am retaining *Oncodochilus* and *Selenochilus* in the Discocephalinae with the proviso that future analysis of these genera may cause me to change my mind and remove them from that position.

Selenochilus nitidus, sp. n

Rich brownish testaceous, very glossy; above overlain with very fine, darker brown, shallow punctures, beneath essentially impunctate except for some extremely fine, vague punctures on the thoracic pleura and submarginal area of the abdomen.

Head three-fourths median length of pronotum, surface somewhat undulant or irregular; vertex feebly elevated, its anterior margin declivous; tylus without a distinct umbo at its middle; punctures irregularly distributed with a vague oblique rugosity evident; lateral margins shallowly sinuate just before eyes and slightly thickened there. Antennae finely setose, medium brown, segment V and apical portion of IV flavescent; segmental ratios: 30/19/-40/50/70, i.e., segment III about twice as long as segment II, segment V longest.

Pronotum two and one-half times as wide across the humeri as long medially, surface slightly convex, punctures unequally distributed, not dense, most of them two to five times as far apart as their own diameters, sparsest across the transhumeral area; cicatrices vague with a posteriorly evanescent pale, median line between them. Scutellum as described for the genus, very slightly longer than wide at base, basal third feebly convex; punctures about twice as far apart as their diameters, vaguely arranged in transverse arcuate lines, leaving a slightly rugose condition across the middle of the disc. Hemelytra more uniformly and densely punctured than elsewhere; free apical margin of corium straight, external apical angle roundly acute; an obscure pale, discal spot present; membranes pale smoky yellow darkening basally, veins concolorous, three in number, and simple. Connexivum uniformly fuscous, very finely and densely punctured, connexival angles rectilinear and not produced.

Bucculae, labrum, and rostrum as described for the genus, the the terminal rostral segment reaching the posterior margin of basal abdominal sternite. Thoracic pleural areas somewhat darker than sternal areas, with fine punctures. Mesosternum shallowly impressed on each side of its median raised ridge. Surface of metasternum tumid, posterior margin truncate. Metapleural ostiole with a raised, short, curved, spatulate auricle which ends abruptly before reaching the middle of the plate; evaporatorium quite extensive. Legs more or less uniformly colored, tibiae and tarsi tending to be a little darker than femora. Abdomen more convex than thorax, some very fine, shallow punctures between the spiracles and lateral margin; no median rostral furrow evident.

Basal plates of female genitalia triangular, slightly longer than wide, their external margins obtusely rounded, their internal apical angles roundly rectilinear, their apical margins feebly sinuate; median plate trapezoidal; apical plates elliptical, well separated from one another, their axes posteriorly convergent, their apices not exceeding the abdominal margin.

Described from one specimen.

Holotype—Female: 8.0 mm. long; 4.0 mm. wide across the humeri; 4.5 mm. wide across the greatest abdominal diameter. Cerro Punta, Chiriqui, Republic of Panama, 13 May 1962 (H. Ruckes). Deposited in the American Museum of Natural History.

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BULLETIN

OF THE

BROOKLYN ENTOMOLOGICAL SOCIETY

Vol. LVIII DECEMBER, 1963 No. 5

UNDESCRIBED SPECIES OF NEMATOCEROUS DIPTERA. PART XIII[1]

By Charles P. Alexander, Amherst, Mass.

The preceding part under this general title appeared in 1963 (Bul. Brooklyn Ent. Soc. 58: 6–11). Species considered at this time include the families Ptychopteridae, Blepharoceridae and Tipulidae, with materials from Assam, Australia, New Caledonia and California. All types of the novelties are preserved in my personal collection.

PTYCHOPTERIDAE

Ptychoptera sikkimensis, n. sp.

Size relatively large (wing of male 10 mm. or more) ; head black, rostrum yellow; mesonotal praescutum and scutum polished black, posterior sclerites of notum orange; pleura yellow dorsally, the ventral portion with major blackened areas; femora yellow, tips abruptly black; tibiae black, the posterior pair with a broad nearly terminal yellow ring; wings brownish yellow, prearcular and costal regions clearer yellow; abdomen yellow basally, the posterior borders of tergites blackened, the amount increasing on outer segments, the end of abdomen, with the hypopygium, black; male hypopygium with outer tergal lobes small and slender.

Male—Length about 10–11 mm.; wing 10–11 mm.; antenna about 4.4–4.5 mm.

Female—about 10 mm.; wing 11 mm.

Rostrum and mouthparts orange; basal three segments of palpus obscure yellow, the terminal segment black. Antennae black, basal half of scape obscure yellow. Head black.

Pronotum and pretergites obscure yellow. Mesonotal prae-

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[1] Contribution from the Entomological Laboratory, University of Massachusetts.

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scutum with disk and the scutal lobes uniformly polished black, humeral region yellowed; scutellum and postnotum orange, ventral end of pleurotergite brownish black. Pleura with major blackened areas on propleura, sternopleurite and ventral pteropleurite, less conspicuously so on lower anepisternum; dorsopleural membrane yellow. Halteres yellow, extreme apex of knob vaguely infuscated. Legs with coxae and trochanters light yellow; femora yellow, tips abruptly black, slightly broader on fore femora; tibiae black, with a broad nearly terminal yellow ring on posterior pair, barely indicated on mid-tibiae; tarsi black. Wings brownish yellow, prearcular and costal fields clearer yellow; very narrow to scarcely evident darkenings in stigmal region, over *r-m* and basal section of M_{3+4}; veins dark brown, more yellowed in the brightened fields. Venation: *r-m* at near three-fourths *Rs;* cell *2nd A* narrower than in *tibialis.*

Basal abdominal segments yellow, posterior borders of tergites blackened, very narrow on segment two, the color increasing in amount outwardly; outer segments and hypopygium uniformly blackened; basal sternites yellow. Male hypopygium with outer tergal lobes small and very slender, tips obtuse, inner lobes corrugated; paired sternal blades short, oval in outline. Dististyle with stem fringed with long light yellow setae, apical spine long and slender.

Habitat—India (Sikkim).

Holotype—♂, Yedang, in *Rhododendron* association, 9,680 feet, 10 June 1959 (Fernand Schmid). *Allotype:* ♀, teneral damaged, Yagtang, in *Rhododendron* association, 11, 600 feet, 17 June 1959. *Paratypes:* ♂♂, Chachu, in *Rhododendron* association, 9,950 feet, 17 May 1959 (Fernand Schmid).

The nearest regional ally is *Ptychoptera tibialis* Brunetti (*atritarsis* Brunetti), which differs in the distinct coloration of the body and legs and in the details of the male hypopygium, including the tergite, dististyle and inner sternal armature.

BLEPHAROCERIDAE

Philorus vanduzeei, n. sp.

Male—Length about 12 mm.; wing 10 mm.; antenna about 1.5 mm.

Female—Length about 13 mm.; wing 10 mm.

Differs from the genotype, *Philorus yosemite* (Osten Sacken), in the unicolorous wings of both sexes and, especially, in the hypopygial structure of the male.

Terminal segment of antenna longer than the penultimate. Wings virtually hyaline in both sexes. Anal lobe of wing much less developed than in *yosemite*, in the latter extended basad to almost opposite the wing insertion. In *yosemite* the wings of male strongly infuscated on about the proximal two-thirds, the apex paling to hyaline, the secondary venation in the cubital and anal fields white and very distinct against the ground. In *vanduzeei* the secondary venation is very faint and more difficult to detect in both sexes. Male hypopygium with the outer dististyle very large, divided into two broadly flattened plates, the outer one narrowed into a point that is tipped with a few long setae; inner blade even larger, more or less folded, the lower parts broadly obtuse. Inner dististyle much smaller, constricted beyond the base, the elongate outer blade with an appressed pendant outer portion.

Habitat—California (San Diego County).

Holotype—♂, mounted on two microscope slides, Alpine, 9 April 1915 (M. C. Van Duzee). *Allotopotype*, ♀, on slide, with the type.

Named for the late Millard C. Van Duzee, distinguished student of the Dolichopodidae. I am indebted to Dr. Charles L. Hogue, Curator of Entomology at the Los Angeles County Museum, and to Mr. D. G. Gibo, who collected material of *Philorus yosemite*.

TIPULIDAE

Plusiomyia kraussiana, n. sp.

Size large (wing of female to 23.5 mm.); general coloration of thorax dark brownish gray, the praescutum with inconspicuous stripes, scutellum abruptly yellowed; antennae with proximal two flagellar segments each with single branches, segments three through nine with two unequal branches that exceed the segments in length; femora yellow, tips abruptly black; wings with a strong brownish tinge, prearcular field more darkened; veins beyond cord without macrotrichia excepting a sparse series on R_{4+5}; vein M_{3+4} very long.

Female—Length about 27–35 mm.; wing 17.5–23.5 mm.; antenna about 4.2–5 mm.

Frontal prolongation of head relatively short, less than the remainder of head, brownish black; no nasus; palpi short, black, terminal segment shorter than the penultimate. Antennae 15-segmented; scape dark brown, pedicel light yellow, flagellum light brown, the branches black; first flagellar segment with a short apical branch, that of the second segment more than twice as long; flagellar segments three to nine inclusive each with two unequal branches, the longest exceeding the segments; four outer segments simple. Head black, sparsely pruinose; anterior vertex less than twice the diameter of the scape.

Pronotum brownish black. Mesonotal praescutum dark brown with four still darker inconspicuous stripes, the intermediate pair strongly narrowed and widely separated behind, lateral praescutal borders more blackened; scutum dark brown, lobes extensively darker; scutellum abruptly yellow, parascutella dark; mediotergite dark, silvery gray pruinose, on either side of basal half with a blackened spot. Pleura and pleurotergite brownish gray, dorsopleural membrane paler brown. Halteres dark brown. Legs with coxae brownish gray; trochanters dark brown; femora yellow, the tips rather narrowly and abruptly black; tibiae yellow; proximal two tarsal segments yellowed, the tips narrowly darkened, outer segments black. Wings with a strong brownish tinge, prearcular field more blackened; veins brown. Veins unusually glabrous, beyond cord with a very few small scattered trichia on distal section of R_{4+5}, the glabrous condition contrasting with that of *neocaledonica* where all veins beyond cord have abundant elongate trichia. Venation: R_{2+3} subequal to Rs; cell M_1 sessile; M_{3+4} very long, about two and one-half to three times the basal section of M_{1+2}.

Abdomen elongate; tergites dark reddish orange, the posterior borders narrowly, the sublateral areas broadly, blackened, lateral tergal borders narrowly light gray; sternites chiefly reddish orange, outer segments more uniformly darkened; genital shield polished black. Ovipositor with cerci very long and slender, virtually straight.

Habitat—New Caledonia.

Holotype—♀, Col de la Pirogue, 13 February 1962 (N. L. H. Krauss). *Paratypes:* 2 ♀♀, Montagnes des Koghis, February 1962 (Krauss).

Named for Noël L. H. Krauss, who has collected insects in every faunal region on earth, and to whom I am indebted for many new and rare crane-flies. The species is entirely different from the only other regional member of the subgenus, *Plusiomyia neocaledonica* Alexander. It is a larger fly with the general coloration of the thorax darkened except for the yellow scutellum, the yellow femora with abruptly blackened tips, and with the costal border of the wing undarkened. Particular attention is called to the unusually glabrous wing veins.

Gymnastes (Paragymnastes) comes, n. sp.

Thorax polished yellow, the praescutal disk and scutal lobes polished black; antennae of male elongate, about two-thirds the wing; femora brownish yellow, tips broadly blackened, preceded by narrow yellowed rings; wings conspicuously patterned with brownish black and white, the cells beyond cord chiefly darkened, with broad white bands before cord and near wing base; basal abdominal tergites light brown, outer segments brownish black; male hypopygium with the outer dististyle blackened, very strongly bent at near midlength, apex obtuse.

Male—Length about 4.5 mm.; wing 4.5 mm.; antenna about 3 mm.

Female—Length about 5.5 mm.; wing 5 mm.

Rostrum yellow, with long black setae; palpi black. Antennae with scape yellow, pedicel brown, flagellum black; in male, antennae very long, flagellar segments elongate-cylindrical, much shorter than in *dasycera,* the erect vestiture correspondingly shorter but conspicuous. Head of male polished dark brown, of female yellow with a transverse brown band on the broad anterior vertex.

In the male, the pronotum and broad lateral margins of the praescutum polished yellow, the disk, with the scutal lobes, polished black, median region of scutum, scutellum and anterior half of mediotergite polished yellow, the last with two confluent black areas on posterior half; pleurotergite weakly darkened. In the female, anterior half of praescutum yellow, central area ferruginous, posterior margin of mediotergite likewise ferruginous. Pleura polished yellow. Halteres brownish black. Legs with coxae and trochanters light yellow; femora brownish yellow, tips broadly blackened, preceded by a narrow more yellowed ring; tibiae and tarsi black; scales of legs broad, leaflike. Wings of male conspicuously patterned, the ground brownish black, with major whitened areas, including a broad band before cord, more obscured behind Cu_1, and with large areas in bases of cells R and M and in the bases of the Anal cells, including the prearcular field; beyond the cord the outer medial cells paler brown than the radial field; veins brownish black, including those in the whitened areas. In the female, wing apex beyond cord more uniformly blackened, central whitened band complete, subbasal whitened areas more confluent, forming a broad diffuse band. Conspicuous macrotrichia on veins beyond general level of origin of *Rs,* including nearly complete series on Cu_1 and *2nd A,* lacking on *1st A.* Venation: R_{2+3+4} about one-third longer than R_3.

Abdominal tergites light brown, sternites yellowed, hypopygium more brownish black. Male hypopygium with the outer dististyle blackened, very strongly bent at near midlength, the apex obtuse.

Habitat—New Caledonia.

Holotype—♂, Montagnes des Koghis, February 1962 (Krauss). *Allotopotype:* ♀.

The only other regional member of the genus with patterned wings is *Gymnastes* (*Paragymnastes*) *dasycera* Alexander, readily told by the much longer antennae of the male, the only slightly patterned wings, and in the structure of the male hypopygium, including the outer dististyle.

Horistomyia oxycantha, n. sp.

Generally similar to the genotype, *Horistomyia leucophaea* (Skuse), differing conspicuously in the structure of the male hypopygium, particularly the phallosome.

Wings with the stigma and darkened seam along vein *Cu* more conspicuous than in *leucophaea.* Venation: Veins R_3 and R_4 only slightly divergent, cell R_3 at wing margin about one-half more extensive than cell R_4 and less extensive than cell R_2; in *leucophaea,* vein R_4 is deflected more strongly toward the wing tip, cell R_3 being from about two and one-half to nearly three times as extensive as cell R_4 and slightly more than cell R_2. Male hypopygium with the phallosome relatively small, the various elements weak and not expanded at their tips, all being extended into acute pale points, the largest element with three or four long slender subterminal spines, subappressed, directed outwardly. In *leucophaea,* the strongest phallosomic element is conspicuously dilated at apex, the weakly developed subterminal spines recurved. *Horistomyia occidentalis* Alexander and *H. victoriae* Alexander have the hypopygial details quite distinct.

Habitat—Australia (New South Wales).

Holotype—♂, Kutinga, near Tamworth, 24 August 1960 (M. Edwards).

THE GENUS *NEOCHRYSIS* IN AMERICA NORTH OF MEXICO (HYMENOPTERA: CHRYSIDIDAE)

By R. M. Bohart[1]

The genus *Neochrysis* Linsenmaier has usually been included under *Chrysis* but this seems to be a purely artificial arrangement. Only one misidentified species has been recorded from our area, but four additional ones are now known to occur in Florida, Texas, Arizona and occasionally somewhat farther north. The genus is obviously Neotropical with an abundance of species in Central and South America. The reported hosts are wasps of the sphecine genus *Podium* and the eumenine genus *Pachodynerus*.

Institutional collections indicated by symbols are: U. S. National Museum (USNM), American Museum of Natural History (AMNH), British Museum of Natural History (BM), Hungarian Natural History Museum (BUDAPEST), Zoological Institute of Lund University (LUND), Museum of Comparative Zoology (MCZ), University of Kansas (KU), University of California at Berkeley (CIS) and at Davis (UCD).

Genus *Neochrysis* Linsenmaier

The genus was partially defined by Linsenmaier (1959, Mitt. Schweiz. Ent. Ges. 32: 73). He included three subgenera, *Neochrysis s.s.*, *Ipsiura* Linsenmaier and *Pleurocera* Guérin (a homonym herein renamed *Pleurochrysis*). The first two of these, along with a new subgenus, *Exochrysis*, have representatives in the United States.

The most obvious generic character of *Neochrysis* lies in the shape of tergite I. It is broad with sharply rounded anterior corners which in normal position nearly touch the metathoracic teeth. Also, the radial (apical) cell of the forewing is broadly open instead of nearly closed as in *Chrysis*. The genitalia are especially distinctive, being very long and thin, the gonostyle simple, the digitus irregular and somewhat clavate. The eighth sternite of the male is unusually large, shovel-shaped, and often protrudes in dried specimens so as to resemble an ovipositor. In addition the basal vein of the forewing is interstitial with the first crossvein or nearly so, tergite III terminates in four to six teeth or lobes, the malar space is short to very short, the parapsides are generally faint, the scapal basin is hardly ever broader in front view than a compound eye, and the tergites usually have dark cross bands. Insofar as known, *Neochrysis* occurs only in the New World.

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[1] Department of Entomology, University of California, Davis.

KEY TO THE SUBGENERA OF *Neochrysis* AND THE SPECIES KNOWN TO OCCUR IN AMERICA NORTH OF MEXICO

1. Pronotum rather sharply edged but without a complete carina 2
   Pronotum with a carinate lateral margin (subgenus *Ipsiura*) 4
2. Tergite III with six distal teeth or angles; scapal basin limited above by a simple, sharp transverse carina; male flagellomeres greatly produced rib-like. (one species, *viridis* Guérin from Chile) . . . . subgenus *Pleurochrysis* Bohart
   Tergite III with four distal teeth; scapal basin not limited above or with a carina having superior branches; male flagellomeres somewhat flattened toward middle of antenna but not produced 3
3. Pit row practically absent, not distinguished by a sharp groove nor a transverse swelling (subgenus *Neochrysis*), neither postscutellum nor propodeum with median projections . . . . *montezuma* Cameron
   Pit row definite, mostly hidden in a deep transverse groove preceded by a swelling (subgenus *Exochrysis*); propodeum with a sharp median projection above . . *panamensis* Cameron
4. Tergite III with a prominent transverse roll or bulge followed by a plainly visible row of elongate rectangular pits, laterally with a large whitish spot . . . . *neolateralis* Bohart
   Tergite III with a low transverse convexity before a somewhat hidden row of small pits 5
5. Tergite III with a laterobasal white spot . . . *genbergi* Dahlbom
   Tergite III all greenish blue . . . . *pilifrons* Cameron

Subgenus (*Neochrysis*) Linsenmaier

Neochrysis Linsenmaier, 1959. Mitt. Schweizerischen Ent. Ges. 32: 74. Type by orig. desig: *Chrysis punctatissima* Spinola 1840 (nec. Villers, 1789) = *carina* Brullé, 1846.

The subgenus *Neochrysis* has tergite III quadridentate, the pit row indefinite or entirely absent; and the pronotum rather sharply edged but not carinate. Some of the other species in this subgenus in addition to *carina* Brullé are *glabriceps* Ducke, *lecontei* Ducke, *paraensis* Ducke, *inseriata* Mocsáry, and *montezuma* Cameron. The following is the only species of *Neochrysis ss.* so far reported in the United States.

Neochrysis (*Neochrysis*) *montezuma* (Cameron)

Chrysis montezuma Cameron, 1888. Biol. Centrali-Amer. I., Hymen., p. 463. Holotype female, Valladolid, Yucatan (BM).

This species is close to *carina* Brullé, the female holotype of which I have seen in the Natural History Museum in Paris. In *montezuma* there is no smooth ridge on the postscutellum, no frontal carinae, the propodeal tooth is less slender, there are no special hairs on male flagellomeres I—II, and the mid notch of tergite III is deeper and narrower. Also, the cuspis is more sharply pointed, and the digitus is stouter.

In addition to the type and several specimens from Mexico (Chiapas, Nuevo Leon, Jalisco, Sinaloa), I have seen one female from Tucson, Arizona, August 12, 1955 (C. W. O'Brien, UCD).

Neochrysis (**Exochrysis**) Bohart, new subgenus

Type: *Chrysis panamensis* Cameron

Diagnosis.—Pronotum somewhat sharp laterally but without a definite carina; mid ocellus enclosed by an inverted, heart-shaped carina; anterior pronotal slope with neither a shiny area nor a definite pair of pits; tergite III with four well formed distal teeth.

Neochrysis (*Exochrysis*) *panamensis* Cameron

Chrysis panamensis Cameron, 1888. Biol. Central-Amer., Hymen. I, p. 464. Holotype female, Chiriqui, Panama (BM).

Chrysis alabamensis Mocsáry, 1914, Ann. Mus. Nat. Hungarici 12: 49. Holotype female, Alabama (BUDAPEST). **New Synonymy.**

This species has the third tergite with a distinct row of pits of which the median pair are large, directed anteriorly, and deep. There is a noticeable swelling before the pit row, and the propodeum bears an upper median ridge-like tooth behind a zone of very coarse punctation on the postscutellum. Other distinctive features are the somewhat flattened flagellum in both sexes, but especially in the male, and the form of the digitus, which tapers rather evenly toward the slender apex.

I have seen specimens from Panama (*panamensis* type), Costa Rica, and Mexico (Colima, Chiapas), as well as three males and five females from eastern United States. The latter are from "Florida" (Mrs. A. T. Slosson, AMNH); DeFuniak Springs, Florida, 3 May (Acc. no. 5407, AMNH); Bradentown, Florida (USNM); Jacksonville, Florida (W. H. Ashmead, USNM); Atlanta, Georgia, 20 May 1940 (P. W. Fattig. USNM and UCD); and Stone

Mt., Georgia, 29 May 1936 (P. W. Fattig, USNM, homotype of *C. alabamensis* Mocsáry by K. V. Krombein).

The host of *panamensis* (as *alabamensis*) has been recorded as *Podium carolina* Rohwer by K. V. Krombein (1958. U. S. Dept. Agr. Monog. 2: 95).

Subgenus (*Ipsiura*) Linsenmaier

Ipsiura Linsenmaier, 1959. Mitt. Schweizerischen Ent. Ges. 32: 74. Type species: *Chrysis marginalis* Brullé. Orig. desig.

Essential characters of the subgenus are: the sharp, longitudinal lateral pronotal carina; the coarsely punctate anterior pronotal slope with special pits absent or obscure; a tendency toward reduction of the median longitudinal pronotal groove; the obtuse apicolateral corner of tergite II; the enclosure of the median ocellus by an inverted U-shaped carina from the scapal basin; and the frequent occurrence of a translucent or whitish laterobasal spot on tergite III. Typical *Ipsiura,* such as *marginalis* Brullé and *ellampoides* Ducke, have a projecting postscutellum, and tergite III has a deflected quadridentate apical margin as well as a whitish laterobasal spot. In the group represented by *leucochila* Mocsáry and *leucochiloides* Ducke the postscutellum is not projecting and tergite III is quadridentate and spotted but not deflected. Similar to these but hexadentate are *lateralis* Brullé, *leucobasis* Mocsáry, *cristata* Mocsáry, *albibasalis* Mocsáry, *longiventris* Ducke, *friesiana* Ducke, *anisitsii* Bischoff, *klugii* Dahlbom, *genbergi* Dahlbom, and *neolateralis* Bohart. In the same group but without a spotted third tergite is *pilifrons* Cameron.

Three species of *Ipsiura* have been found within our boundaries, one from Florida, one from southeastern Texas, and the other from the southern section of the country as far north as 38 degrees in Kansas, Illinois and Virginia.

Neochrysis (*Ipsiura*) *genbergi* (Dahlbom)

Chrysis genbergi Dahlbom, 1854. Hym. Europeae 2: 319. Holotype female, Brazil (LUND).

A female in the collection of the U. S. National Museum is labeled "Fla." It agrees closely with material in the Natural History Museum at Paris from Minas Gerais, Brazil, determined as *genbergi* by du Buysson. Except for the large white lateral spot on tergite III it is very similar to *pilifrons* Cameron. Minor points of difference are the slightly broader interocular area and the longer subantennal distance (1.2 times mid ocellus diameter instead of 0.8

times) in *genbergi*. It differs from *neolateralis*, which is also white-spotted, by the U-shaped rather than V-shaped carina enclosing the mid ocellus, and by the low and weakly defined swelling before the pit row.

Neochrysis (Ipsiura) neolateralis Bohart, n. sp.

Chrysis lateralis of authors, not Brullé.

Male.—Length 9 mm. Dark green with purplish areas on vertex and thorax, purplish bands across abdominal tergites, a large creamy spot along pit row from base of tergite III almost to outermost tooth; sternite II with a pair of large black submedian, subbasal spots; flagellomere I bluish above; wings lightly brown stained in cellular area. Scapal basin with fairly dense, somewhat appressed silvery hair, pale inconspicuous hair on rest of body. Punctation moderate to coarse, mostly moderate and close, sublaterally on tergite II about one-half diameter apart, fine in scapal basin, summit of postscutellum rough, area of tergite III beyond pit row mostly smooth. Head about as broad as long, least interocular distance about equal to length of scape; flagellomere I about 1.3 times length of II in inner view; subantennal space 1.0 times mid ocellus diameter, interantennal space 0.9 times and malar space 0.2 times; scapal basin without a definite cross carina but an inverted and somewhat U-shaped carina above it encloses mid ocellus; ocelli slightly lidded; fore femur with an angle beneath at distal two-thirds; mesopleuron with two distinct teeth and other irregularities; propodeal tooth blunt, hardly lobed beneath; tergite III with a strongly bulging roll before elongate pit row, followed by short, single-edged teeth, outermost one rounded, median notch not depressed nor shiny at base, lateral edge of tergite broadly and evenly bowed out; genitalia slender, aedeagus not drawn out at apex.

Female.—Essentially as in male. Angle of fore femur forming a short, sharp ridge.

Holotype male.—West Frankfort, Franklin Co., Illinois, 5 July 1963 (R. M. Bohart, UCD).

Paratypes.—10 males, 17 females. **Kansas:** Atchison Co. (R. H. Beamer, KU); Stockdale, Riley Co. (UCD); Bourbon Co. (R. H. Beamer, KU). **Arkansas:** Pyatt, Marion Co. (J. C. Downey, Univ. So. Illinois). **Illinois:** Crabtree Orchard Lake, Williamson Co. (J. C. Downey, UCD). **D. C.:** Washington (J. C. Bridwell, USNM). **Virginia:** Falls Church (N. Banks, MCZ). **Georgia:** Atlanta (P. W. Fattig, USNM); College Park (P. W. Fattig, USNM). **Texas:** "Texas" (UCD);

Brownwood, Brown Co. (M. A. Cazier, AMNH); Austin, Travis Co. (J. E. Gillaspy, AMNH); Somerset, Atascosa Co. (A. J. Adelson, CIS); Llano Co. (J. E. Gillaspy (AMNH, CIS, UCD); Nueces River, Uvalde Co. (J. Bequaert, MCZ). Also in Mexico and Central America as follows: **Sinaloa:** Mazatlán (R. and K. Dreisbach, Dreisbach collection); Elota (F. Parker, L. Stange, UCD). **Nayarit:** Navarrete (C. and P. Vaurie, AMNH), **Jalisco:** Plan de Barrancas (F. Parker, L. Stange, UCD). **Morelos:** Temisco (F. Parker, L. Stange, UCD) **Puebla:** Petlalcingo (F. Parker, L. Stange, UCD). **El Salvador:** Quezaltepeque (M. Irwin, D. Cavagnero, UCD).

Neochrysis (*Ipsiura*) *pilifrons* (Cameron)

Chrysis pilifrons Cameron, 1888. Biol. Centrali-Amer. I, Hymen., p. 465. Holotype male, Panama (BM).

Chrysis stenops Mocsáry, 1889. Monog. Chrysidarum, p. 571. Lectotype female, Tampico, Mexico (GENEVA) Present desig.

This species has tergite III unspotted, the pit row greatly sunken and slit-like, and the frons at the narrowest point less than the length of the scape. In addition, there is a short carina from the unlidded lateral ocellus obliquely forward to the compound eye. The outermost tooth of tergite II is not so sharp as the others. This is especially true in the type of *stenops*.

In addition to the type specimens listed above, I have seen a female lectoparatype at the Natural History Museum in Vienna from Orizaba, Mexico, and a female at the U. S. National Museum from Brownsville, Texas, June.

Subgenus *Pleurochrysis* Bohart, new name

Pleurocera Guérin, 1842. Rev. Zool (Soc. Cuv.) 5: 149. Type species by monotypy: *P. viridis* Guérin, 1842, Chile. Preoccupied by *Pleurocera* Rafinesque, 1818. Amer. Mon. Mag. 3(5): 355 (Mollusca).

The subgenus is known only from the type species, *P. viridis* Guérin, which occurs in Chile. Tergite III has six teeth but no pale markings, the scapal basin is limited above by a sharp transverse carina, the pronotum is not carinate laterally, and the postscutellum has a sharp median longitudinal ridge. However, the most striking feature of the genus is the foliaceous antenna of the male in which most of the flagellomeres are flattened and produced outward somewhat rib-like. The host is reported to be *Pachodynerus gayi* (Spinola) by H. Janvier (1933, Ann. Sci. Nat. Zool, Paris (ser. 10) 16: 292, as *"Odynerus gayi"*).

OBSERVATIONS ON THE BIOLOGY OF *TIPULA FOOTEANA* ALEXANDER (DIPTERA: TIPULIDAE)

By Benjamin A. Foote[1]

During the Spring of 1959, several fourth instar larvae of a species of *Tipula* were collected from a mudflat bordering Robinson's Lake in Latah County, Idaho. Later, the laboratory-reared and feral adults were forwarded to Dr. C. P. Alexander, who subsequently described them as representing a new species (1961, Great Basin Nat. 21: 11). The purposes of the present paper are to present observations on the life history and to give descriptions of the immature stages.

The larval habitat consists of an extensive mudflat lying along the northeast shore of Robinson's Lake on either side of the small inlet stream. The shallow lake, located approximately eight miles east of Moscow, was formed during the 1930's by damming a small southflowing stream. Although the eastern and western shores of the lake are partially wooded, the mudflat itself is unshaded and during the summer months supports a lush growth of reed canary grass (*Phalaris arundinacea* L.). The larvae were most abundant among the roots of this grass, although a few were discovered several feet away from any vegetation. All were taken in the upper two inches of soil, and a few were located by the slight surface ridges produced as they progressed through the mud.

Numerous larvae were discovered on March 27, several more were collected on April 25, but none were found during a two-hour search of the habitat on May 10. No pupae or pupal exuviae were discovered before April 5, they were abundant by April 25, but only a few were obtained after May 10. Adults began to appear during mid-April, became very abundant during late April and early May, but had largely disappeared by early June. No adults were seen during numerous trips to the mudflat during the summer and fall months. The collecting records indicate that *footeana* is univoltine, with overwintering apparently occurring as last instar larvae. Pupation takes place during April, with adults reaching a peak of abundance during late April and early May.

Teneral females were found to contain large numbers of apparently mature eggs, and, in the laboratory, adults mated within two days after emerging from pupae. Oviposition generally took place within four days after emergence.

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[1] Department of Biology, Kent State University, Kent, Ohio. This research supported by a grant from the American Philosophical Society.

Efforts to rear larvae in the laboratory were only partially successful as a complete life cycle was not obtained. On May 10, a female taken in copula at the mudflat was transferred to the laboratory at the University of Idaho. After the head, legs and wings were removed, she was floated on a slight amount of water in a small Petri dish (see Laughlin, 1958, Entomol. Exp. and Appl. 1: 241–245, for a discussion of this technique). Egg-laying began quickly and within an hour 51 eggs had been obtained. No additional oviposition occurred until the following day when her abdomen was torn slightly by cutting the pleural membrane near the thoracic-abdominal junction. Within three hours after this treatment, she produced an additional 149 eggs. Dissection two days later disclosed that all of the mature eggs had been deposited.

The eggs possess a coiled, thread-like filament at the end opposite the micropyle. When placed in water, the filament gradually uncoils and then resembles a pale thread extending approximately one centimeter from the egg. According to Robinson (1956, Proc. Univ. Durham Phil. Soc. 12: 175–182) terminal filaments are found on eggs of species that oviposit in habitats where there is a danger of the eggs being washed away. He believes that the partially uncoiled filament reduces this possibility by becoming entangled in stationary debris and acting as an anchor. Certainly the mudflat at Robinson's Lake is subjected to periodic flooding, and the anchoring function ascribed to the terminal filament would seem to have considerable survival value.

Approximately 150 eggs were placed on moist filter paper in small Petri dishes and allowed to develop at room temperatures. The remaining eggs were preserved. Hatching began on May 16, six days after eggs were deposited, and continued until May 18. Only 55 of the 150 eggs hatched, the remainder became covered by mold and were obviously inviable. Hatching occurred from the micropylar end of the egg.

Dried powdered grass was added to the dishes containing newly hatched larvae. This material, when moistured, was fed upon readily, and larval growth was fairly rapid. Ten larvae molted into the second instar on May 24 and 25, giving a first larval stadium lasting eight to nine days. Two second instar larvae molted again on May 29, giving a second larval stadium of approximately five days. One larva passed into the fourth instar on June 8, indicating that the third larval stadium lasts about ten days. This larva lived for an additional 22 days, but died before pupating. The rearing results indicate that the first three larval stadia are passed through quickly, but that the final larval stadium is greatly lengthened and probably serves as the overwintering stage.

On both March 27 and April 25 larvae of undetermined species of *Tabanus* and *Chrysops* were abundant in the mudflat, along with numerous larvae of dolichopodids and other tipulid genera, particularily *Limonia*. In the laboratory, the *Tabanus* larvae fed voraciously on the fourth instar *footeana* larvae, while the dolichopodids readily attacked the earlier instar larvae. No *Chrysops* larvae were seen feeding on the tipulids.

DESCRIPTIONS OF IMMATURE STAGES

Egg (Fig. 12).—Length 0.98–1.04 mm. ($\bar{x} = 1.01$ mm.); width 1.33–1.41 mm. ($\bar{x} = 1.38$ mm). Elongated-ovoid, with one side more flattened. Chorion shining dark brown to black, without sculpturing. Micropyle subapical on convex side of egg, situated in center of raised, subcircular pit. End opposite micropyle with pale, coiled terminal filament between one and two centimeters in length. (Based on 30 specimens).

First instar larva (unfed)—Length 1.98–2.32 mm. ($\bar{x} = 2.25$ mm.); width 0.35–0.42 mm. ($\bar{x} = 0.40$ mm.). Pale yellow; each segment with darker annulus posteriorly; integument subtransparent, with abundant minute hairs and numerous long, pale setae.

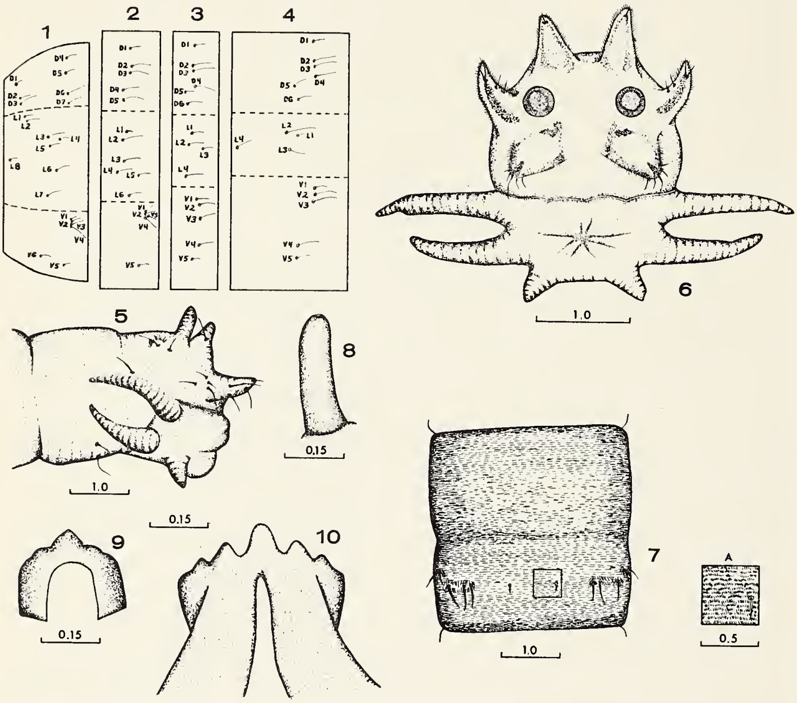
Spiracular disc (Fig. 11) with two lateral and two ventral lobes; each lateral lobe with narrow, dark brown stripe, apex with brush of 15–20 long, pale setae; each ventral lobe lightly pigmented, apex with brush of 10–15 long setae. Dorsal border of disc with eight pencils of paired setae, those nearest midline longest. Anal papillae four, pale, slender and tapering, subequal in length.

Head capsule lightly pigmented; antennae slender and hair-like; mentum with five blunt teeth, median tooth longest. (Based on 10 specimens).

Second and third instar larva—Very similar to fourth instar larva, differing primarily in smaller size and in having less pigmentation on spiracular disc.

Fourth instar larva (Figs. 1–10).—Length 30.0 to 36.0 mm. ($\bar{x} = 34.0$ mm); width 3.0 to 3.5 mm. ($\bar{x} = 3.2$ mm). Yellowish brown to grayish brown in color, with vague indication of middorsal stripe running length of abdomen, paler ventrally; color fading in specimens preserved in alcohol. Cuticle densely clothed with hairs; dorsum of fifth abdominal segment with hairs arranged in short lines with ends of lines indistinct (Fig. 7A); lines of hairs more widely spaced along middorsal line. Numerous longer hairs around base of setae D2-4 and D5 (Fig. 7). Lateral region with abundant scattered short hairs, these not arranged in lines or only vaguely so, without clusters of long hairs. Venter with short hairs arranged in transverse lines similar to dorsal pattern, with weak cluster of longer hairs slightly anterior to setae V1–V3.

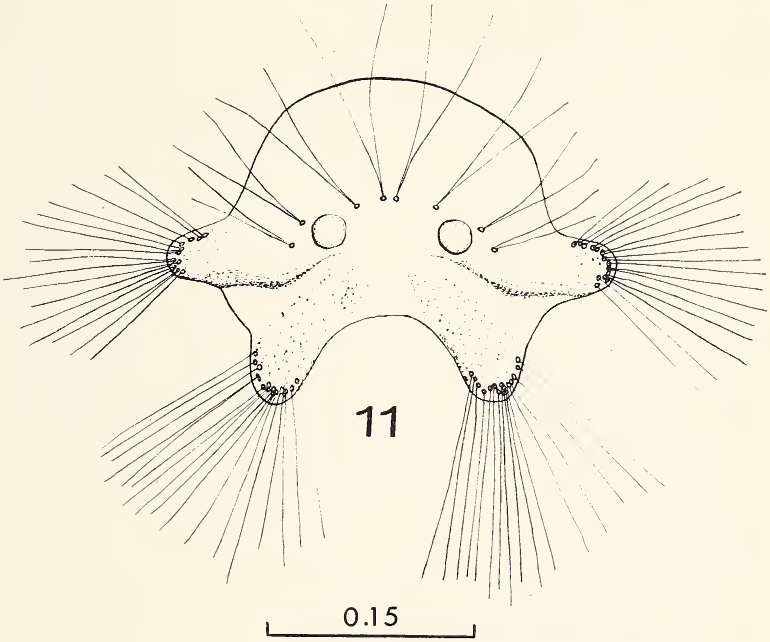
The chaetotaxy, very similar to that illustrated for *Tipula flavolineata Meigen* (Chiswell, 1956), is as follows. Dorsum of prothorax (Fig. 1) with seven setae arranged in two rows; in anterior row D2 and D3 arise close together, D3 longer than D2, D1 short; in posterior row D6 and D7 arise close together, D6 longest. Lateral region with eight setae: L1 very short and close to L2, L3, L4, and L5 close together, L8 very short and close to anterior margin of segment. Venter with six setae; V1–V4 very close together, V3 and V4 about twice length of V1 and V2, V5 and 6 closer to mid-



Structures of fourth instar larva of *Tipula footeana* Alex. Fig. 1, Chaetotaxy of prothorax. Fig. 2, Chaetotaxy of mesothorax and metathorax. Fig. 3, Chaetotaxy of first abdominal segment. Fig. 4, Chaetotaxy of abdominal segments two through seven. Fig. 5, Lateral view of eighth abdominal segment. Fig. 6, Posterior spiracular disc. Fig. 7, Dorsum of fifth abdominal segment showing chaetotaxy and distribution of microhairs; A, Enlarged view of portion of dorsum. Fig. 8, Antenna. Fig. 9, Hypopharynx. Fig. 10, Mentum.

ventral line and with V6 anterior to V5. Setal patterns of mesothorax and metathorax very similar to each other (Fig. 2). Dorsum of each segment with five bristles; D2 and D3 long and nearly contiguous, D4 and D5 close together, D5 slightly longer than D4. Lateral region with six setae. Venter with five setae, V1–V4 very close together, V1 shortest, V5 near midventral line and slightly anterior to V1–V4.

First abdominal segment shorter than remaining segments, with setae arising near its mid-length (Fig. 3). Dorsum with six setae arranged in anterior row of two (D5 and D6) and posterior row of four (D1–D4), with D2 and D3 close together and closer to D4 than to D1. Lateral region with four setae, L1–L3 fairly close to-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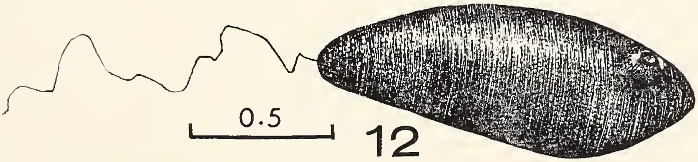

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Fig. 11, Posterior spiracular disc of first instar larva. Fig. 12, Egg.

gether, L4 more anterior, L2 and L4 longer than L1 and L3. Venter with five setae, V1–V3 close together, V4 and V5 slightly anterior to V1–V3, V3 and V4 longer than other setae. Abdominal segments two through seven each divided into long anterior and short posterior annuli. Setal patterns similar, with all setae except L4 arising on posterior annuli (Fig. 4). Six dorsal setae on each side arranged in two rows, D2 and D3 close together; four lateral setae, L1–L3 in small triangle with apex directed posteriorly, L1 short, L4 far forward near margin of segment; five ventral setae, V1–V3 close together, V1 shortest, V4 and V5 anterior of V1–V3. Eighth abdominal segment with spiracular disc on posterior surface (Fig. 5). Each dorsal lobe of disc without setae on anterior surface; each lateral lobe with one long seta on anterior face near mid-length; each ventral lobe with one very short seta near apex, one long seta at mid-length, two slightly shorter setae along ventral margin and four setae on base. Each dorsolateral surface of segment with two long setae anterior to bases of dorsal and lateral lobes, more anterior seta partially surrounded by short hairs; each lateral surface with long seta anteriorly; each ventrolateral surface with two setae near midventral line anterior to anal field.

Spiracular disc (Fig. 6) with dorsal and lateral lobes subequal in length and width, ventral lobes somewhat shorter and broader. Lobes with numerous marginal hairs. Each dorsal lobe with pigmented marginal stripes, stripes broader at bases of lobes; each lateral lobe with central dark stripe ending before apex of lobe; each ventral lobe with pigmented marginal stripes that join at base of lobe, with elongate black spot near apex and with small transverse dark spot at base. Posterior surface of disc glabrous except for numerous hairs and setae on marginal lobes. Each dorsal lobe with short seta near apex; each lateral lobe with four setae, two close together near apex and two along dorsal margin near base; each ventral lobe with five setae, one long seta arising in clear area at tip of apical dark spot, four shorter setae arising near apex of lobe near marginal hairs. Spiracles subcircular, stigmatic scars black, peritremes brown.

Anal field with six papillae; dorsal ones longest and about four times longer than wide; lateral lobes nearly as long as dorsal lobes; ventral lobes short and bluntly rounded.

Mentum of head capsule with five distinct teeth anteriorly, median tooth largest (Fig. 10); hypopharynx (Fig. 9) with well developed median tooth and two blunt lateral teeth; each antenna (Fig. 8) elongate, with small apical papilla. (Based on 20 specimens).

THE LIFE HISTORY OF *FITCHIA APTERA* STÅL (HEMIPTERA-HETEROPTERA: REDUVIIDAE)

By RUSSELL M. DECOURSEY[1,2]

Fitchia aptera Stål is one of the less well known bugs of the North American Reduviidae. It lives on the ground at the bases of tall grass clumps such as those in abandoned fields and is seldom abundant. Readio (1927), for example, does not give the life history of this species. Adults have been taken occasionally by sweeping tall grass, especially in the early evening, but during the day they remain secluded on the ground. Nymphs invariably have been collected on the ground usually in grassy areas but when placed in cages they climb and remain near the top of the cage on any available foliage.

Adults pass the winter in hibernation under stones, boards, or around the roots of grass clumps. They begin to appear in April in Connecticut in sunny, protected places presumably at some distance from their place of hibernation.

Distribution.—This species ranges from the east coast of the United States to the Rocky Mountains and into the southwest. The recorded range is from Maine south to South Carolina and west to Utah, Oklahoma and Texas. Blatchley (1926), Fracker (1912), Readio (1927), Van Duzee (1917).

Rearing Methods.—Nymphs were reared in 16 ounce black top jars at room temperature. Each jar contained a small branch of blueberry (*Vaccinium sp.*). Blueberry was selected simply because it retains its leaves well for several days. The nymphs seem better able to catch their prey if they can hide among leaves and branches. Small flies were introduced daily into the cages. The nymphs tend to become cannibalistic if they are not well fed. *Drosophila* sp. and various other species of small flies are quite acceptable as food for both nymphs and adults. Nymphs and occasionally adults of the following families also are accepted as food: Cicadellidae, Cercopidae and Membracidae (Homoptera). Aphids and a variety of species of beetles were not accepted. Nymphs may be reared without water being supplied. However, fourth instar nymphs were observed inserting their stylets into freshly cut apple, presumably to obtain water. They also take water from wet paper toweling.

Duration of egg and nymphal stages.—The duration of the egg stage is 9–14 days, averaging 10 days. The insects remain as

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[1] Department of Zoology and Entomology, University of Connecticut, Storrs, Conn.

[2] Acknowledgement is made to the University of Connecticut Research Foundation for financial support.

first instar nymphs for 8–11 days, averaging 9.6 days. The second instar time period is 8–10 days with an average of 9 days and the nymphs remain in the third instar 8–11 days, averaging 9.5 days. The nymphs remain in the fourth instar for the greatest length of time, 17–22 days, averaging 18.7 days. The total time period from egg to adult is 51–67 days with an average of 60 days. These results are based on a small number of rearings and this plus uncontrolled laboratory conditions may account for the variations in different stages.

The evidence from rearing indicates that *Fitchia aptera* has only four instars. All but one of the reared emerging adults were brachypterous forms but even the macropterous one had four instars. There have been several references in the literature to Hemiptera having only four nymphal instars. These insects are usually wingless or micropterous forms but not necessarily so. Torre-Bueno (1917) reports *Microvelia borealis* Torre-Bueno as having four nymphal instars and describes the stages. Hoffman (1925) confirms Torre-Bueno in reporting four nymphal instars for *M. borealis* and adds *M. buenoi* Drake to the list of semiaquatic Hemiptera having only four instars. In addition, Hoffman reports rearing *Nepa apiculata* Uhler and finding only four instars. Frick (1949) reported that the normal number of instars for *Microvelia capitata* Guerin in the Panama Canal Zone is 5 but that eight apterous males and one apterous female had only four nymphal stages out of a total of 110 reared from egg to adult, 76 of which were apterous.

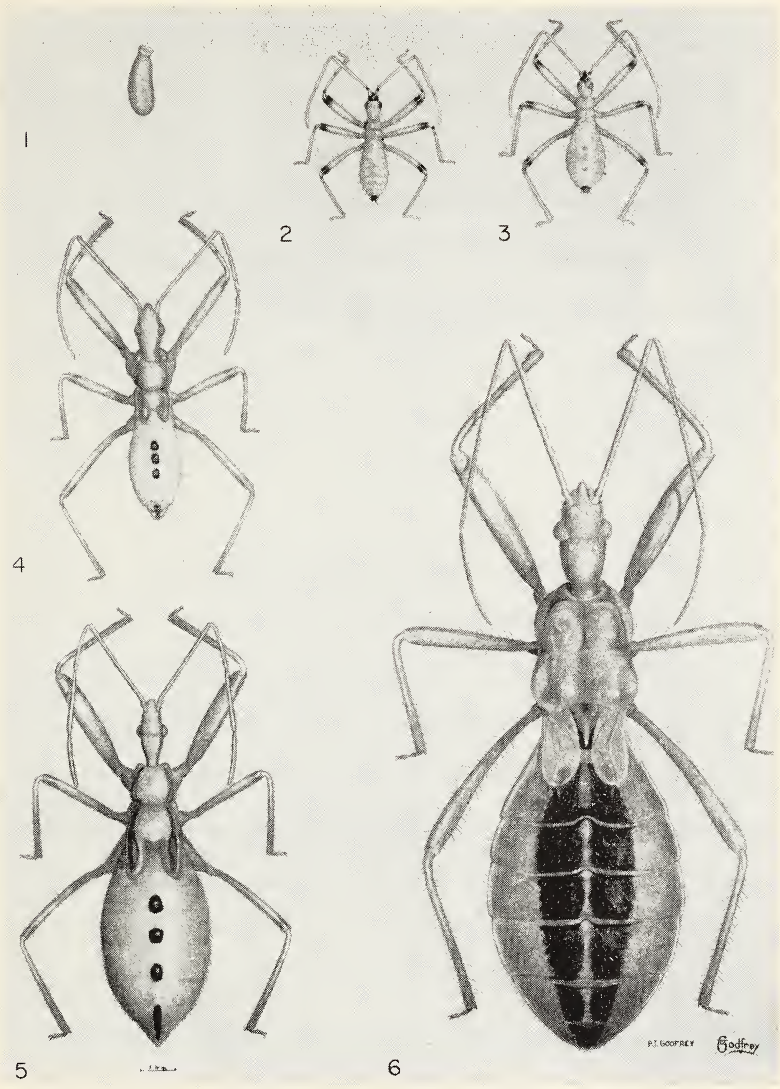
Southwood and Fewkes (1961 describing the immature stages of the common British Nabidae report *Dolichonabis limbatis* (Dahlbom) as having only four nymbal instars and that *D. lineatus* (Dahlbom) probably has a similar life cycle. These are almost always micropterous forms. Readio (1927) found only four instars in the reduviid, *Melanolestes picipes* Herrich-Schaeffer.

The phenomenon of reduction of instars from five to four in Heteroptera is of particular significance since it is usually associated with brachyptery or aptery. It is of interest also in that it appears to be confined to predacious forms. This may indicate a possible neotinic condition associated with wing polymorphism.

Description of Stages.

The egg (Figure 1).—The pale brown eggs are laid in clusters averaging 12 eggs per cluster. They are glued to leaves and stems of plants. The length is 2 mm, width at middle, 0.625 mm. The chorion is plain, the micropylar processes are short and flat, forming a compact cap. The red eye spot of the developing nymph

DECOURSEY PLATE V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Stages in the life history of *Fitchia aptera.* Fig. 1, The egg. Fig. 2 First instar. Fig. 3, Second instar. Fig. 4, Third instar. Fig. 5, Fourth instar. Fig. 6, Adult.

can be seen through the chorion as well as some indication of segmentation and the outline of appendages in the later stages of embryonic growth.

First instar (Figure 2).—The emerging first instar nymph is a pale cream color with lateral red stripes along the abdomen. Before feeding, it measures 2.45 mm. in length and 0.49–0.5 mm. in width across the abdomen. After feeding, it attains a length of 2.8–2.9 mm. and the width of the abdomen increases to 1.26 mm. The head anterior to the eyes is black. Length of head 0.6 mm.; width of head behind the eyes at the widest point is 0.35 mm; interocular space 0.28 mm. The rostrum is stout, curved, with three apparent segments. The short distal segment is a darker color. The antennae are as long as the body and setaceous. The segments are dark colored except the terminal ones which are red. Ratio of antennal segments 55: 18: 20: 60.

The legs are long, pale, almost translucent and setaceous. The distal ends of the femora and the proximal ends of the tibiae are black. Forelegs raptorial but femora not greatly enlarged. The terminal portions of the tarsi are dark also. Tarsi two-segmented, the first segment very short and inconspicuous.

Thorax and abdomen pale except the two posterior segments of the abdomen which are piceous. Each of these segments bears two strong, dark colored curved spines on the dorsal aspect. Three dorsal scent gland openings are present but inconspicuous.

Second instar (Figure 3).—Length 3.85–4.2 mm.; maximum width of abdomen 0.9–1.26 mm.; length of head 0.9 mm.; width of head 0.42–0.49 behind eyes; interocular space 0.3–0.35 mm.; ratio of antennal segments, 59: 20: 22: 62. The second instar nymph resembles the first instar except in size. The color is nearly the same. There is a slight change in body proportions; the head is a little longer, the thoracic segments better defined and the abdomen is a little larger. The legs and antennae more strongly setaceous. The openings of the dorsal abdominal scent glands are more evident.

Third instar (Figure 4).—Length 6.5 mm.; width of abdomen 1.4 mm.; length of head 1.0 mm.; width of head 0.5–0.63 mm.; interocular space 0.4 mm. ratio of antennal segments, 90: 29: 43: 68. The head appears longer and there is a stout spine at the base of each antenna. A brown stripe extends laterally on either side along the head, over the notum and wingpads.

The prothorax is better developed in this instar and wing pads are evident, arising from the caudal margins of the meso- and metanota. The metathoracic wing pads extend posteriorly over the first abdominal segment. Prothoracic femora somewhat enlarged. Color of legs light brown with darker areas at distal ends of femora.

Color of abdomen, light brown; lateral margins tinged with red. First abdominal spiracles dorsal in position, those of segments 2–8 ventral in position. Dorsal scent gland openings along anterior margins of segments 4, 5 and 6 are conspicuously located in shiny black areas. A median dorsal, dark colored area persists on the three posterior segments. Just anterior to this dark area are two dark colored papillae on either side of the midline, each bearing a dark colored seta.

Fourth instar (Figure 5).—Length 9.0 mm.; width of abdomen 2.45 mm.; length of head 2.1 mm.; width of head behind eyes 0.7 mm.; interocular space 0:53 mm. The head has become considerably longer in proportion to its width. Ratio of antennal segments, 120:35:60:78. The brown stripe which extends laterally on either side of the head, pronotum and over the wingpads is more pronounced in this instar. The borders of the wingpads are nearly black. Rostrum strong and curved.

The prothorax has developed a collar anteriorly with flattened ridges laterally along the pronotum. Wing pads arising from the caudal margins of the meso- and metanota extend posteriorly over the second abdominal segment. The legs are pale brown to brown. The dark areas at the distal ends of the femora are not as prominent as in earlier instars. The forefemora are enlarged.

The abdomen is considerably larger than in the preceding instar. The color is pale brown with the narrow scent gland openings located in three piceous areas. A median dorsal piceous stripe is located on the three posterior segments.

After approximately 18 days the fourth instar emerges as an adult (Figure 6) which is 11.5 mm. long and characterized by a wide black median dorsal stripe extending along the abdomen. The adult has ocelli, may be brachypterous or macropterous and the tarsi are 3-segmented. The pronotum is not armed with spines.

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9 December 1964

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NEW SPECIES OF ERIOPTERINE CRANE FLIES FROM SOUTHERN ASIA (TIPULIDAE: DIPTERA)

Charles P. Alexander[1]

The species discussed herewith belong to the vast tribe Eriopterini which includes a majority of the small and medium sized species in the Tipulidae. The materials are from various parts of India and Ceylon, where they were collected by Dr. Fernand Schmid, outstanding student of the Trichoptera, with one further species that was taken by Dr. Edward I. Coher in Afghanistan. The types of the novelties are preserved in my collection of world Tipulidae and allied families.

BAEOURA Alexander

Erioptera (*Baeoura*) Alexander; Ent. Soc. America, 17: 67; 1924 (type *nigrolatera* Alexander, South Africa).

Although originally placed with *Erioptera, Baeoura* actually is much closer to *Cryptolabis* Osten Sacken, being distinguished therefrom chiefly by the very different venation of the radial field of the wing. Very numerous species occur in the Oriental region with fewer in the Ethiopian.

Baeoura angustisterna, n.sp.

Size very small (wing of male less than 4 mm.); mesonotum gray, praescutum with a broad dark brown central stripe and intensely blackened oval areas on sides; setae of legs inconspicuous; wings grayish subhyaline, vein *Sc* short; male hypopgium with tergal lobes very slender, ninth sternite unusually long and narrow, setuliferous; phallosome including a relatively short slender straight

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[1] Contribution from the entomological laboratory, University of Massachusetts.

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aedeagus, the gonapophyses much broader, terminating in short paired obtuse blades.

Male: Length about 3 mm.; wing 3.8 mm.

Rostrum and palpi black. Antennae black throughout; flagellar segments oval, the outer ones more elongate. Head gray.

Pronotum brownish gray, pretergites and sides of scutum yellowed. Mesonotal praescutum light gray with three conspicuous darkened areas, the broad central stripe dark brown, the oval lateral areas intensely blackened, subcircular in outline; posterior sclerites plumbeous gray. Pleura black, sparsely pruinose; dorsopleural membrane brown. Halteres dark brown. Legs with coxae and trochanters brown; remainder of legs dark brown with inconspicuous setae. Wings grayish subhyaline, prearcular and costal fields slightly more whitened; veins brown. Prearcular field unusually long and narrow. Venation: Sc short, Sc_1 ending about opposite midlength of Rs, the latter a little shorter than R; vein R_4 bent caudad, generally parallel to the distal section of R_5; $m\text{-}cu$ at from one-fourth to one-fifth M_{3+4}; cell *2nd A* narrow.

Abdomen, including hypopygium, black. Male hypopygium with a broad U-shaped emargination on posterior border of tergite, the lateral tergal lobes extended into narrow glabrous blades with obtuse apices, at their bases with unusually long setae. Ninth sternite darkened, unusually long and narrow, its length about five to six times the greatest width, near outer end with several long setae, the entire surface with abundant microscopic setulae. Basistyle with a small darkened apical lobe. Dististyle terminating in a gently curved rod that narrows gradually to the obtuse tip. Phallosome including a relatively short and slender straight aedeagus, the tip acute; gonapophyses much broader, short, terminating in paired short obtuse blades.

Habitat: India (Madras). *Holotype:* ♂, Senbaganur, 5,500–6,500 feet, December 7, 1958 (Fernand Schmid).

Other regional species having vein *Sc* of the wings unusually short and with the dististyle of the hypopygium generally similar include *Baeoura acustyla* Alexander, *B. primaeva* Alexander, and *B. sternata* Alexander, all differing in thoracic coloration and especially in hypopygial structure, including the tergal lobes, ninth sternite and phallosome. The sternite of the present fly proportionately is narrower than in other species.

Baeoura bilobula, n.sp.

General coloration of thorax black, the praescutum intensely so;

femora brownish black, tibiae and tarsi paler, the segments with very long erect setae; wings strongly darkened; male hypopygium with posterior end of tergal plate produced into obtuse lobes; sternite bilobed, with long setae; dististyle boomerang-shaped.

Male: Length about 4–4.3 mm.; wing 5–5.3 mm.; antenna about 1.3–1.4 mm.

Rostrum and palpi dark brown. Antennae dark brown; outer flagellar segments progressively more slender, with very long verticils. Head dark brown, the front and broad orbits light gray; setae erect and very long.

Pronotum dark brown. Mesonotal praescutum intensely black, scutum more gray pruinose, scutellum light brownish gray, the postnotum again blackened; praescutal setae long, erect. Pleura black, the membranes paler. Halteres brownish black, base of stem narrowly yellowed. Legs with coxae brownish black; trochanters brown; femora brownish black, tibiae and tarsi brownish yellow, outer segments darker; legs with very long erect setae. Wings strongly darkened, stigmal region restrictedly and very vaguely more darkened; whitened streaks along veins *M* and *1st A*; veins dark brown. Costal and posterior wing fringes very long, especially the latter. Venation: Sc_1, ending about opposite fork of *Rs*, the latter subequal to or about one-third longer than *R*; *m-cu* at near midlength of M_{3+4}; cell *2nd A* narrow.

Abdomen dark brown, the small hypopygium blackened. Male hypopygium with the tergal plate long, outer lateral angles produced into obtuse points or knobs, laterally on either side with a row of five or six peglike structures. What appears to represent the sternite is a conspicuous bilobed structure, the inner margins of the lobes with long setae. Dististyle brownish yellow, boomerang-shaped. Aedeagus broad-based, narrowed to the slender apex. Eighth sternite terminating in a rounded knob.

Habitat: India (Sikkim). *Holotype:* ♂, Palam, 5,100 feet, April 25, 1959 (Fernand Schmid). Paratopotypes: 5 ♂♂, with the type.

In the strongly darkened wings and erect setae of the legs the present fly suggests *Baeoura funebris* (Alexander), of the eastern Himalayas, which differs especially in hypopygial structure, including the lateral lobe of the dististyle. Other Indian species that have very long setae on the legs include *B. irula*, n.sp., *B. nilgiriana* Alexander, *B. pollicis* Alexander, and some others in South India and Ceylon, and *B. subnebula* Alexander, of Nepal, all differing conspicuously in the coloration of the wings and structure of the hypopygium.

Baeoura bistela, n.sp.

General coloration gray; antennae black; halteres infuscated; legs black, setae of femora inconspicuous, of tibiae and basitarsi longer; wings weakly infuscated; male hypopygium with posterior border of tergite truncate, with yellow lateral blades; dististyle terminal, very long and slender; phallosome including the elongate aedeagus and still longer pale gonapophyses.

Male: Length about 4.8–5 mm.; wing 4–4.2 mm.

Female: Length about 4.5 mm.; wing 4.3 mm.

Rostrum brown; palpi black. Antennae black, pedicel very large; verticils of proximal flagellar segments very long. Head light brownish gray; anterior vertex broad.

Pronotum dark gray, sides of scutellum obscure reddish. Mesonotum light gray, praescutum with a broad darker central stripe and poorly differentiated lateral areas; posterior border of scutellum restrictedly reddish brown. Pleura gray, dorsopleural membrane buffy. Halteres infuscated, base of stem narrowly light brown. Legs with coxae gray; trochanters yellowish brown; remainder of legs black, femoral setae sparse and inconspicuous, those of tibiae longer, of basitarsi long and conspicuous. Wings weakly infuscated, costal border more whitened, stigma very vaguely darker; veins pale brown, cord more darkened, veins of costal region paler. Venation: R_{2+3+4} subequal to basal section of R_5.

Abdomen dark brown. Ovipositor with the fleshy valves obscure orange. Male hypopygium with the tergite transverse, gently narrowed outwardly, posterior border truncated, the lateral angles produced into flattened yellow blades that are directed slightly mesad. Dististyle terminal, unusually long and slender, only a little shorter than the basistyle; base enlarged, thence gently curved to the subacute tip; surface with scattered microscopic punctures, before apex with a long erect seta. Phallosome with three elongate pale elements, the two gonapophyses longer than the relatively stout aedeagus, the latter narrowed very gradually to an acute point; apophyses subparallel throughout their extent, near apex constricted and twisted to the acute tip.

Habitat: India (Assam). *Holotype:* ♂, Nongjni, United Khasi-Jaintia Hills, 3,750 feet, April 19, 1960 (Fernand Schmid). *Allotopotype:* ♀, pinned with type. *Paratypes:* ♂ ♀, Nongrim, Khasi-Jaintia, 1,800 feet, March 27, 1960; ♂ ♀, Nongjrong, Mikir-Cachar, 2,700 feet, April 25, 1960 (Fernand Schmid)

Baeoura bistela is quite distinct from other regional species in the hypopygial structure, particularly the long slender gonapophyses.

A conspicuous development of these latter structures is very uncommon in the genus but is found also in the genotype, *B. nigrolatera* (Alexander), of southeastern Africa.

Baeoura irula, n.sp.

Size large (wing over 5 mm.); general coloration of mesonotum brown with four poorly indicated darker stripes; halteres infuscated; legs brownish yellow, with long conspicuous setae; wing veins with very long trichia, *Rs* longer than *R*; male hypopygium with apex of dististyle bifid, the upper lobe with six or seven long subretrorse setae.

Male: Length about 4.5 mm.; wing 5.3–5.5 mm.

Female: Length about 4.5 mm.; wing 5.2 mm.

Rostrum brownish yellow, palpi pale brown. Antennae brown; flagellar segments subcylindrical, the outer ones more slender, all shorter than their verticils. Head light gray, with very long setae.

Pronotum light brown, yellowed on sides and behind, setae long; pretergites yellowed anteriorly. Mesonotal praescutum brown, with four poorly indicated darker stripes, sides gray pruinose, vestiture very long, erect; scutum brownish gray, scutellum obscure yellow; mediotergite gray, pleurotergite brownish gray. Pleura gray; dorsopleural membrane obscure yellow. Halteres infuscated, base of stem narrowly yellowed. Legs with fore coxae light brown, remaining coxae and all trochanters yellow; remainder of legs brownish yellow, extreme tips of tibiae and the outer tarsal segments darker; vestiture of legs long and conspicuous. Wings whitened, stigma and a seam over cord pale brown, Anal cells paler brown; veins brown, prearcular and costal field paler. Venation: *Rs* from one-third to one-half longer than *R* and about three times R_{2+3+4}; veins beyond cord long, much as in *Erioptera; m-cu* at near midlength of M_{3+4}; cell *2nd A* narrow, especially outwardly.

Abdomen, including hypopygium, brown. Male hypopygium with the tergite large, arched, posterior border convex, with strong setae; median area farther produced into a small shield-shaped area. Dististyle large, arcuated, apex bifid, the lobes unequal with obtuse tips; margin of the larger upper lobe with six or seven long subretrorse setae. Aedeagus stout, the tip upcurved to an acute point.

Habitat: India (Madras). *Holotype:* ♂, Kodaikanal, 6,500–7,200 feet, December 5, 1958 (Fernand Schmid). *Allotopotype:* ♀, pinned with type. *Paratopotype:* 1 ♀, pinned with type; *paratype:* ♂, Gudalur, 4,000–6,500 feet, January 7, 1959 (Fernand Schmid).

The structure of the aedeagus is somewhat as in the otherwise quite different *Baeoura palmulata,* n.sp. The simple lobe of the tergite and the bifid apex of the dististyle provide strong characters for the recognition of the species.

Baeoura longiloba, n.sp.

General coloration of thoracic dorsum blackened, sparsely pruinose to appear plumbeous, scutellum conspicuously orange yellow; halteres infuscated; legs brownish black, vestiture inconspicuous; wings weakly infuscated, vaguely patterned with darker, *Rs* about one-half longer than *R*; male hypopygium with both the tergal lobes and the dististyle unusually long and slender; apex of ninth sternite broadly obtuse; phallosome with short obtuse gonapophyses and a very short pale aedeagus.

Male: Length about 4 mm.; wing 4.3 mm.

Rostrum light brown, palpi slightly darker. Antennae dark brown; flagellar segments beyond the proximal three or four elongate, shorter than their verticils. Head light gray.

Pronotum chiefly brown, the sides and the pretergites yellowed. Mesonotal praescutum and scutum almost uniformly blackened, with a sparse gray bloom to appear plumbeous and subnitidous; scutellum conspicuously orange yellow, restrictedly darkened medially at base; parascutella and postnotum blackened. Pleura blackened, sparsely pruinose; dorsopleural membrane obscure yellow. Halteres infuscated, base of stem restrictedly obscure yellow. Legs with coxae infuscated, trochanters more brownish yellow; remainder of legs brownish black, femoral bases restrictedly yellowed; segments with inconspicuous vestiture. Wings weakly infuscated, stigmal region and a vague seam over cord slightly darker, base and costal field more whitened; veins brown. Venation: *Rs* about one-half longer than *R;* R_{2+3+4} nearly three times R_{2+3}; R_2 transverse, pale brown; *m-cu* before fork of *M*; cell *2nd A* relatively broad.

Abdomen dark brown throughout. Male hypopgium with tergal lobes unusually long and slender, entirely glabrous, tips obtuse, their length seven or eight times the width. Ninth sternite elongate, the apex broadly obtuse. Dististyle terminal, unusually long, about equal in length to the basistyle, widest at near midlength; outer half of nearly uniform diameter, the tip obtuse; setae sparse, restricted to outer half and chiefly near apex. Phallosome pale, including short obtuse gonapophyses and a very short slender aedeagus.

Habitat: India (Assam). *Holotype:* ♂, Luanglong, Khunou, Manipur, 2,500 feet, May 28, 1960 (Fernand Schmid).

Baeoura longiloba is best told from other regional members of the genus by the blackened mesonotum, inconspicuous setae of legs, and especially in the hypopygial details, as the unusually long and slender tergal lobes and dististyle and the structure of the phallosome. The very short aedeagus of the unique type does not appear to be broken and appears to represent a normal condition.

Baeoura naga, n.sp.

General coloration dark brown, sides of praescutum with a major oval black area; rostrum brown, antennae black; segments of legs brown with darker tips, the tibiae and tarsi with long erect setae; wings gray with a broad pale brown band over the cord; male hypopygium with lateral tergal lobes appearing as slender spines; dististyle a long sinuous rod, at near two-thirds the length on outer margin with a slender lobe; aedeagus stout, apex unequally bifid.

Male: Length about 4.5–4.6 mm.; wing 4.5–5 mm.; antennae about 1–1.1 mm.

Female: Length about 5 mm.; wing 5 mm.

Rostrum brown, palpi black. Antennae black throughout. Head gray.

Thorax above almost uniformly dark gray, sides of praescutum with a major oval black area. Pleura light gray: dorsopleural membrane brown. Halteres infuscated, base of stem slightly more reddened. Legs with coxae and trochanters brown; femora, tibiae and basitarsi brown, the tips darker, remainder of tarsi brownish black; tibiae and tarsi with conspicuous long erect setae, those of femora more appressed. Wings gray, prearcular and costal regions more whitened; a broad pale brown band crossing wing at cord, more intense anteriorly, with a second paler suffusion near the wing base; veins brown. Venation: Sc long, Sc_1 ending shortly before fork of R_{2+3+4}, Sc_2 retracted, Sc_1 alone about one-half longer than R_{2+3+4}; $m\text{-}cu$ shortly before midlength of M_{3+4}.

Abdomen dark brown. Male hypopygium with the tergite transverse, posterior border truncate, each outer lateral angle produced into a slender spine with long setae at its base. Dististyle distinctive, appearing as a long sinuous rod, tip obtuse, at near two-thirds the length on outer margin with a slender lobe, farther distad with a low obtuse protuberance. Aedeagus a stout yellow rod, near apex bifid to form a longer spike and a shorter subterminal spine.

Habitat: India (Mysore). *Holotype:* ♂, Kulgunda, 1,000–1,250 feet, January 21, 1959 (Fernand Schmid). *Allotopotype:* ♀, pinned with type. *Paratopotypes:* ♂ ♀, with the types.

Baeoura naga is entirely distinct from other regional members of the genus, especially in the hypopygial structure, including the tergite, dististyle and aedeagus. The coloration of the thorax is much as in the genotype, *B. nigrolatera* (Alexander) of southeastern Africa but the hypopygial structure is entirely different.

Baeoura palmulata, n.sp.

Mesonotal praescutum blackened, the remainder of thorax more plumbeous gray; halteres darkened; legs dark brown, the setae very conspicuous; wings subhyaline, with a vague pale brown cloud along cord; R_{2+3+4} long, about three times R_{2+3}, cell *2nd A* narrow; male hypopygium with tergal lobes slender, ninth sternite terminating in a short obtuse darkened lobe; dististyle a flattened dark colored paddlelike blade; aedaegus large, yellow, flattened, narrowed gradually outwardly, the tip a slightly upcurved spine.

Male: Length about 4 mm.; wing 4.3–4.5 mm.

Female: Length about 4 mm.; wing 4.2 mm.

Rostrum and palpi blackened. Antennae dark brown; pedicel only moderately enlarged, flagellar segments slender, the outer verticils very long. Head light gray.

Pronotal scutellum light yellow, in cases the entire pronotum uniformly darkened. Mesonotal praescutum blackened, the posterior sclerites of notum dark gray. Pleura dark plumbeous gray. Halteres darkened, base of stem narrowly yellowed. Legs with fore coxae darkened, remaining coxae more brownish testaceous; remainder of legs dark brown, very conspicuously hairy. Wings subhyaline, with a vague brown cloud extending from the stigma across the cord; veins brown. Venation: *Rs* long, about one-third longer than *R;* R_{2+3+4} long, about three times R_{2+3}; *m-cu* close to midlength of M_{3+4}; cell *2nd A* narrow.

Abdomen entirely dark brown. Male hypopygium with tergal plate large, gradually narrowed outwardly, outer lateral angles produced into long slender glabrous lobes that are separated by a broad U-shaped emargination. Ninth sternite produced into a short darkened obtuse lobe. Dististyle a simple flattened dark colored paddlelike blade. Aedeagus yellow, large, flattened, gradually narrowed and arcuated outwardly, the tip a slightly upcurved spine.

Habitat: India (Assam). *Holotype:* ♂, Dawkin, Khasi-Jaintia Hills, 200 feet, April 8, 1960 (Fernand Schmid). *Allotype:* ♀, Cherrapunji, Khasi-Jaintia Hills, 4,500 feet, October 14, 1960. *Paratypes:* 2 ♂♂, with the allotype; 1 ♂, Nongjni, Khasi-Jaintia Hills, 3,750 feet, April 19, 1960.

Baeoura palmulata is closest to *B. angustilobata* (Alexander), of southeastern China, which differs in details of all hypopygial structures, including especially the tergite, sternite, dististyle and phallosome.

Baeoura platystyla, n.sp.

Size medium (wing of male 4.2 mm.); general coloration of thorax plumbeous gray, the mesonotal scutellum extensively obscure orange; halteres dusky; femora, tibiae and basitarsi brownish yellow to yellow, their tips narrowly darkened; wings pale gray with two broad inconspicuous slightly darker bands; male hypopygium with dististyle broad, the lower apical angle produced into a slender beak; phallosome including very long slender gonapophyses that appear lyriform, exceeding the sinuous aedeagus.

Male: Length about 4 mm.; wing 4.2 mm.

Rostrum brown, palpi dark brown. Antennae brownish black, the enlarged pedicel black; flagellar segments elongate. Head light gray.

Pronotal scutum brownish gray, its posterior border and the scutellum brownish yellow. Mesonotal praescutum and scutum almost uniformly light gray, vaguely patterned with darker plumbeous gray; scutellum obscure orange, the central part of base darkened; postnotum plumbeous gray. Pleura dark gray; dorsopleural membrane extensively light brown. Halteres dusky, base of stem restrictedly brightened. Legs with fore and middle coxae darkened, posterior pair paler; trochanters brownish yellow; femora and tibiae obscure brownish yellow, tips narrowly blackened; basitarsi yellowed, outer tarsal segments blackened; vestiture of femora short and inconspicuous, of tibiae and tarsi longer, not erect. Wings pale gray, with two broad inconspicuous slightly darker diffuse bands, one at level of origin of *Rs*, the other at the cord; prearcular and costal fields pale yellow; veins pale brown, those comprising the cord darker brown, in the brightened fields more brownish yellow. Venation: *Rs* long, subequal to *R*; R_{2+3} erect, subequal to R_2; *m-cu* before midlength of M_{3+4}.

Abdomen dark brown. Male hypopygium with the tergite large, subquadrate, posterior border truncate, the outer angles produced into the very broad obtuse glabrous lobes. Dististyle distinctive, very broad, the lower apical angle produced into a slender rostrum. Phallosome including the slender sinuous aedeagus and the much larger gonapophyses, the latter appearing lyriform, each broad on proximal third, thence suddenly narrowed, the tip a long straight spine.

Habitat: India (Assam). *Holotype:* ♂, Nongjrong, United District of Mikir and North Cachar Hills, 2,700 feet, April 25, 1960 (Fernand Schmid).

The most similar regional species is *Baeoura bistela,* n.sp., which has the phallosome somewhat the same in the elongate gonapophyses, differing in all other details of the hypopygium, including the slender tergal lobes and very different dististyle and phallosome.

Baeoura taprobanes, n.sp.

Size medium (wing of male about 4 mm.); general coloration of thorax plumbeous; legs light brown, conspicuously hairy; wings whitish subhyaline, vaguely patterned with darker, costal fringe and vein trichia very long, *Rs* about one-half longer than *R*; male hypopygium with the tergite terminating in a low broad central lobe; dististyle a simple curved blade, the apex narrowly obtuse, with two pale spinoid setae; aedeagus a simple stout nearly straight spinelike organ, narrowed to the acute tip.

Male: Length about 3.8 mm.; wing 4.1 mm.

Rostrum brownish yellow; palpi dark brown. Antennae with the scape brown, the enlarged pedicel and flagellum brownish black. Head light gray; setae erect, long and conspicuous.

Pronotum brownish gray. Mesonotum plumbeous, any pattern present concealed in mounting medium. Mesopleura light plumbeous, the posterior sclerites paler; dorsopleural membrane buffy. Halteres broken. Legs with coxae and trochanters yellowed, fore coxae darkened; remainder of legs light brown, conspicuously hairy. Wings whitish subhyaline, cord and anal cells very vaguely darkened; veins brown, those of the cord somewhat darker. Costal fringe and trichia of veins very long. Venation: *Rs* about one-half longer than *R; m-cu* about its own length beyond fork of *M*; cell *2nd A* narrow, especially outwardly.

Abdomen dark brown. Male hypopygium with the tergite large, gently narrowed outwardly, terminating in a broadly transverse glabrous lobe, its apex virtually truncate; sides of tergite with five or six strong setae. Dististyle a simple stout blade, curved beyond midlength, the extreme apex narrowly obtuse, before tip with two or three strong pale spinoid setae. Aedeagus a simple nearly straight pale spine, broadest at base, narrowed very gradually to the acute tip, the outer third very gently sinuous but not bent.

Habitat: Ceylon. *Holotype:* ♂, Lindula, 4,100 feet, March 3, 1954 (Fernand Schmid).

Baeoura taprobanes is most readily distinguished from other regional species that have unusually hairy legs and wing veins by the hypopygial structure. The most similar species is *B. irula,* n.sp., which is readily told by the tergite, dististyle and aedeagus.

Baeoura tricalcarata, n.sp.

Size medium (wing slightly less than 5 mm.); general coloration black, pruinose, in teneral individuals paler; male hypopygium with posterior border of tergite produced into three elongate glabrous lobes with obtuse tips; dististyle elongate, near apex with two small spinoid setae; aedeagus at apex extended into an acute point.

Male: Length about 3.5–4 mm.; wing 4.2–4.8 mm.

Female: Length about 3.5 mm.; wing 4.8 mm.

Rostrum brownish yellow; palpi dark brown. Antennae with scape obscure yellow, remainder dark brown; flagellar segments long-subcylindrical, shorter than the verticils. Head light brown; anterior vertex broad.

Thorax of the type light brown, of the paratype almost black, pruinose, the latter evidently the normal fully colored condition. Halteres whitened. Legs of type pale, almost whitened, of the paratype much darker; segments with long pale setae. Wings whitish subhyaline to light gray; veins brown. Venation: *Sc* ending about opposite four-fifths to five-sixths the long *Rs,* the latter about one-third to one-half longer than *R; m-cu* at near one-third to one-half M_{3+4}.

Abdomen brown to almost black. Male hypopygium with the tergite large, the posterior border produced into three elongate glabrous lobes, the tips obtusely rounded, before apex with two small spinoid setae. Aedeagus broad at base, the outer end a narrow curved horn, tip acute.

Habitat: India (Sikkim). *Holotype:* ♂, Lathong, 6560 feet, May 15, 1959 (Fernand Schmid). *Allotopotype:* ♀, pinned with type. *Paratype:* ♂, Kechoiperi, 5,900 feet, April 9, 1959 (Fernand Schmid).

Baeoura tricalcarata is entirely different from other regional members of the genus in the tridentate tergite of the male hypopygium.

Baeoura trisimilis, n.sp.

General coloration of mesonotal praescutum blackened, more intense laterally, scutellum clear light yellow; legs medium brown, conspicuously hairy; wings very weakly infuscated, slightly patterned with darker; costal fringe and vein trichia very long and conspicuous; *Sc* long, Sc_1 ending just beyond fork of *Rs,* the latter about one-fourth longer than *R,* cell *2nd A* narrow; male hypopygium with the dististyles and aedeagus generally similar in outline, appearing as yellow blades, the aedeagus narrowed to the slender microscopically angulatd tip.

Male: Length about 4.5 mm.; wing 5.3–5.6 mm.

Rostrum light brown, palpi darker brown. Antennae brownish black; flagellar segments elongate. Head brownish gray.

Pronotum brownish gray, pretergites yellowed. Mesonotal praescutum blackened, the lateral margins intensely so, disk with indications of slightly more plumbeous stripes; scutum brown, scutellum clear light yellow, the base at midarea and the parascutella darkened; postnotum dark brown; mesonotal praescutum and scutum with very long erect setae. Pleura with mesepisternum blackened, propleura and metapleura paler; dorsopleural membrane obscure yellow. Halteres brown, extreme base of stem obscure orange. Legs with coxae light brown; trochanters brownish yellow; remainder of legs medium brown, with very long outspreading pale setae. Wings very weakly infuscated, slightly darker at stigma and over cord and vein *Cu*; veins brown. Costal fringe and vein trichia very long and conspicuous, the latter on virtually all longitudinal veins. Venation: *Sc* long, Sc_1 ending just beyond fork of *Rs*, Sc_1 alone slightly exceeding the sinuous *m-cu; Rs* about one-fourth longer than *R;* R_{2+3+4} about twice the perpendicular R_{2+3}; *m-cu* at near midlength of M_{3+4}; cell *2nd A* narrow.

Abdomen dark brown. Male hypopygium with the tergite narrowed outwardly, terminating in a subquadrate glabrous lobe, the apex virtually truncate. Dististyle a gently curved yellow blade, apex narrow, with a lower subtending flange on margin that does not attain the tip. Aedeagus of approximately the same size and shape as the dististyle but narrower, especially outwardly, the slender tip microscopically angulated and with a tiny tubercle before apex.

Habitat: India (Assam). *Holotype:* ♂, Rumkheng, United Khasi-Jaintia Hills, 5,500 feet, March 24, 1960 (Fernand Schmid). *Paratopotype:* ♂.

Baeoura trisimilis is well distinguished from other regional species by the coloration of the thorax and wings and especially by the hypopygial structure. Species with the aedeagus most similar to this species are *B. funebris* Alexander and *B. nilgiriana* Alexander.

ERIOPTERA Meigen

Erioptera Meigen; Illiger's Mag., 2: 262; 1803.

Erioptera comprises a vast group of small crane flies, with representatives in all biotic regions. Numerous species belonging to several subgenera are found in southern Asia, particularly in the Himalayas and their southern spurs.

Erioptera (Erioptera) balioptera, n.sp.

Belongs to the *alboguttata* group, allied to *paivai;* wings short and broad, dark colored, with twelve large whitened areas, including a larger one before the ends of the anal cells; male hypopygium with the interbase unusually long and slender, at midlength bent at a right angle.

Male: Length about 3 mm.; wing 3.6 mm.

Rostrum and palpi black. Antennae with scape and pedicel brownish black, basal flagellar segment brown, the remainder yellowed; proximal two flagellar segments fused into a suboval structure; outer segments long, shorter than the verticils which are longest on the intermediate segments. Head yellow; eyes large.

Pronotum obscure yellow above, darkened laterally; pretergites whitened. Mesonotal praescutum brownish yellow to fulvous, lateral borders narrowly darkened, scutum fulvous, scutellum and central region of mediotergite darkened, the parascutella and lateral areas of postnotum yellowed. Pleura chiefly dark brown. Halteres yellow, base paler. Legs with coxae infuscated; trochanters brownish yellow; remainder of legs yellow, femoral bases vaguely more darkened, tibiae and tarsi clear light yellow. Wings shorter and broader than in *paivai;* ground strongly infuscated, more so on costal third in radial field, prearcular and costal fields somewhat more yellowed; a series of about twelve large circular whitened areas, the largest at cord; the other areas at origin of *Rs,* over fork of *M,* and at ends of longitudinal veins from R_{1+2} to *2nd A,* including also a larger area in both anal cells before outer end of cell *2nd A*; veins yellow, virtually invisible in the whitened areas. Venation: Vein *2nd A* sinuous; due to their color the positions of crossveins and deflections lying in the whitened areas are not sufficiently distinct to describe.

Abdomen dark brown. Male hypopygium with structure generally as in *paivai,* including the long spine on the outer dististyle, the chief differences being in the inner dististyle, interbase and phallosome. Inner style with setae of outer margin very long, fully one-half the length of the style; interbase unusually long and slender, at midlength bent at a right angle, tip acute, the base not dilated but with a small pale lobule that is provided with delicate setae. Phallosome appearing lyriform, the apophyses blackened, the apex of each with a few weak denticles.

Habitat: India (Assam). *Holotype:* ♂, Serrarim, United Khasi-Jaintia Hills, 5,500 feet, October 6, 1960 (Fernand Schmid).

The various species that center about *Erioptera* (*Erioptera*) *alboguttata* Edwards (Formosa) include also *E.* (*E.*) *daisenica* Alexander (Honshu), *E.* (*E.*) *leucosticta* Alexander (western China, and *E.* (*E.*) *paivai* Alexander (India). The last species, together with the present fly, differs from the others in the spined outer dististyle. It may be emphasized that the wing pattern in *paivai* has the last whitened area placed at the end of vein *2nd A* and not as described above for the present fly.

Erioptera (Erioptera) brahma, n.sp.

Mesonotal praescutum light gray with four poorly indicated pale brown stripes; a conspicuous dark brown central vitta on pronotum and anterior end of praescutum, pleura brownish black; knobs of halteres blackened; legs black, tarsi slightly paler; wings light orange, including the veins; male hypopygium with tip of inner dististyle recurved, terminating in an acute spine; gonapophysis near base with a conspicuous spine.

Male: Length about 5–5.5 mm.; wing 6–6.4 mm.

Female: Length about 6 mm.; wing 6.5 mm.

Rostrum dark brown, palpi black. Antennae with the proximal six or seven segments yellow, the outer ones more elongate and weakly darkened. Head brown, orbits yellowed.

Pronotum dark brown medially, paling to yellow on sides. Mesonotal praescutum light gray, with four poorly indicated pale brown stripes, the intermediate pair anteriorly separated by a narrow dark brown median line that is continuous with the pronotal darkening, posterior interspaces paler brown; scutal lobes gray, yellowed behind, central area with a narrow darker line, scutellum and postnotum dark brown. Pleura dark brown to brownish black, sparsely pruinose. Halteres with stem pale yellow, knob abruptly black. Legs with coxae brownish gray, trochanters obscure yellow; femora and tibiae black, tarsi slightly paler. Wings light orange, stigmal region elongate, more saturated yellow; veins and macrotrichia deep orange yellow. Venation as in the subgenus, vein *2nd A* long and sinuous.

Abdomen dark brown to brownish black. Male hypopygium with median region of posterior border of what is interpreted as being the tergite produced into a stout darkened lobe. Basistyle with mesal apical lobe relatively small. Outer dististyle a simple glabrous blade that narrows gradually to an acute point; inner style shorter, yellow, sinuous, the apex darkened, recurved, terminating in an acute spine. Gonapophyses appearing as a single pair of blackened horns, curved to the acute tip, on mesal face at base with a long acute spine.

Habitat: India (Sikkim.) *Holotype:* ♂, Zema, 9,100 feet, June 14, 1959 (Fernand Schmid). *Allotopotype:* ♀, pinned with type. *Paratypes:* ♂ ♀, Chumzomoi Choka, in *Rhododendron* association, 11,800 feet, July 8, 1959; 1 ♂, Lachung, 8,610 feet, July 10, 1959; 1 broken specimen, Yagtang, in *Rhododendron* association, 11,650 feet, July 17, 1959; 1 ♂, Yumtang, in *Rhododendron* association, 12,140 feet, June 27, 1959 (Fernand Schmid).

Erioptera (*Erioptera*) *brahma* is readily told from all other regional members of the subgenus by the blackened legs and knobs of the halteres and in the somewhat striking unpatterned orange wings. No other species has such a combination of characters.

Erioptera (Erioptera) litostyla, n.sp.

General coloration pale brownish yellow; antennae, halteres, legs and wings yellow; male hypopygium with both dististyles simple, the outer a slender blackened blade, inner style about one-half as long, subcylindrical; phallosome with four blackened spines, the inner pair shorter, slightly curved.

Male: Length about 4.5 mm.; wing 5 mm.; antenna about 1 mm.

Female: Length about 5 mm.; wing 6 mm.

Rostrum light brown, palpi black. Antennae light yellow, outer flagellar segments somewhat darker. Head yellow.

Pronotum yellow, weakly darkened medially, pretergites light yellow. Mesonotum almost uniformly pale brownish yellow, the praescutal stripes scarcely differentiated except at the slightly darker extreme anterior ends; pseudosutural foveae pale; mediotergite faintly infuscated, pleurotergite yellowed. Pleura pale yellow with a broad pale brown dorsal stripe. Halteres pale yellow. Legs yellow. Wings yellow, veins darker yellow; macrotrichia pale brown. Venation: as in the subgenus, vein *2nd A* long and very strongly sinuous.

Abdominal tergites obscure brownish yellow, infuscated medially, posterior borders broadly yellow; sternites pale yellow. Male hypopygium with basistyle only slightly produced at apex, the larger lobe with very long setae. Both dististyles simple, the outer a blackened blade, inner style about one-half as long, subcylindrical, nearly glabrous, tip obtuse. Phallosome with four blackened spines, the gonapophyses slightly shorter, gently curved, the outer apophyses (or interbases) a little longer and nearly straight.

Habitat: India (Sikkim). *Holotype:* ♂, Lachen, 8,900 feet, June 13, 1959 (Fernand Schmid). *Allotopotype:* ♀.

Erioptera (*Erioptera*) *litostyla* is readily told from other generally similar regional species by the yellow halteres and legs and especially by the hypopygial structure, including the dististyles and phallosome.

Erioptera (Erioptera) pila, n.sp.

General coloration yellow, including the rostrum, bases of antennae, legs and wings; male hypopygium with the inner dististyle bispinous, including the slender apical point; gonapophyses appearing as simple blackened rods.

Male: Length about 5.5–6 mm.; wing 6.5–7 mm.

Female: Length about 6–7 mm.; wing 6.5–7.5 mm.

Rostrum yellow, palpi black. Antennae yellow basally, the outer flagellar segments becoming progressively darker, the outermost light brown. Head yellow.

Thoracic dorsum yellow, praescutum with poorly delimited more fulvous stripes, the narrow median line vaguely still darker. Pleura light yellow, with faint indications of a pale brown dorsal stripe. Halteres with stem light yellow, knob brown. Legs yellow, the last two tarsal segments darker. Wings pale yellow, the costal border more saturated yellow; veins pale yellow, difficult to see in balsam mounts. Venation as in the subgenus, vein *2nd A* very sinuous.

Abdominal tergites yellowed, narrowly brown medially; basal sternites pale yellow; outer segments, including the genitalia, dark brown. Male hypopygium with posterior border of ninth tergite unequally trilobed, including widely separated setiferous lateral lobes and a much lower median elevation. Outer dististyle slender, narrowed outwardly, tip obtuse; inner style distinctive, the outer two-thirds strongly recurved, terminating in a slender black spine, the dilated base of the recurved portion with microscopic setigerous tubercles; outer margin of style at near midlength with a strong black spine. Gonapophyses appearing as nearly straight black rods.

Habitat: India (Sikkim). *Holotype:* ♂, Yagtang, in *Rhododendron* association, 11,650 feet, July 17, 1959 (Fernand Schmid). *Allotopotype:* ♀, with the type. *Paratopotypes:* several of both sexes, 11,600–11,650 feet; *paratypes* ♂ ♀, Sherabtang, in *Rhododendron* association, 12,700 feet, August 28, 1959 (Fernand Schmid).

The specific name, '*pila*' is hindi for yellow and was suggested by

Dr. Schmid, together with several others. The species is most similar to others such as *Erioptera* (*Erioptera*) *brahma*, n.sp., and *E.* (*E.*) *palliclavata* Alexander having unpatterned yellow or orange wings, differing evidently in the hypopygial structure, particularly the bispinous inner distisyle.

Erioptera (Tasiocerodes) cnephosa, n.sp.

General coloration of the entire body and appendages brownish black to black; wings weakly tinged with brown; vein R_2 complete, directed basad, joining R opposite termination of vein Sc_1; male hypopygium with outer lobe of basistyle with very long setae; outer dististyle a flattened dark blade, at apex suddenly narrowed into a slender rod; basal style pale, apex dilated, irregular; interbase a powerful curved rod, narrowed to an acute spine; phallosome including slender spinelike apophyses.

Male: Length about 3.5–4 mm.; wing 3.5–4.4 mm.

Female: Length about 4 mm.; wing 4 mm.

Rostrum, palpi and antennae black; flagellar verticils very long. Head brownish black.

Pronotum blackened, pretergites obscure yellow. Mesothorax uniformly dull black; vestiture of praescutum sparse but long and conspicuous. Halteres with stem dusky, base yellow, knob dark brown. Legs dark brown throughout. Wings faintly tinged with brown, prearcular and costal fields a trifle more yellowed; veins and the long conspicuous trichia brown. Venation: R_{2+3+4} present as a short element that is about one-half the perpendicular R_{2+3}, with R_2 at the angulation of the latter, appearing as an entire arcuated element directed backwards, connecting more basally with R_1, this vein variable in length, in the type exceeding R_{2+3}.

Abdomen brownish black, hypopygium somewhat paler brown. Male hypopygium with mesal face of basistyle at apex with a pale lobe that bears very long setae, those near apex longer. Outer dististyle a flattened dark blade, at apex suddenly narrowed into a somewhat shorter slender rod; second style far basad, pale, expanded on outer half, irregular in conformation, including a slender pale rod. Interbase a powerful curved rod that narrows into an acute blackened spine. Phallosome including the slender aedeagus and subtending spinelike apophyses that are blackened, narrowed into acute points.

Habitat: India (Sikkim and West Bengal). *Holotype:* ♂, Tashigang, Sikkim, 3,120 feet, September 29, 1959 (Fernand Schmid). *Allotype:* ♀, Tinglin, Sikkim, 2,950 feet, September 28, 1959.

Paratopotypes: ♂♂, with the type; *paratypes:* 1 ♂, with the allotype; ♂♂, Chumtang, Sikkim, 5,120 feet, July 18, 1959; ♂, Teng, Sikkim, 4,600 feet, August 1, 1959; 1 ♂, Lingsoka, West Bengal, 3,930 feet, September 7, 1959 (Fernand Schmid).

Erioptera (*Tasiocerodes*) *cnephosa* is quite different from the other regional member of the subgenus, *E.* (*T.*) *nepalensis* Alexander, which has vein R_2 represented only by a short spur and with all details of the male hypopygium distinct.

Erioptera (Psiloconopa) hirsutissima, n.sp.

General coloration yellow, the praescutum and scutal lobes conspicuously patterned with dark brown; pleura with a broad white longitudinal stripe that is bordered by pale brown; legs with very long setae, yellow, tips of segments narrowly darkened; wings pale yellow, restrictedly patterned with brown; abdomen yellow, both the tergites and sternites narrowly lined laterally with brownish black; male hypopygium with two simple apical dististyles, the inner one shorter, the tip acute and blackened; gonapophyses black, conspicuous.

Male: Length about 4.3–4.5 mm.; wing 4.5–4.8 mm.

Female: Length about 5.5 mm.; wing 5.8 mm.

Rostrum yellow, palpi black. Antennae brownish black; basal flagellar segments short-cylindrical, outer segments more elongate; verticils of the more proximal articles very long, nearly four times the segments, the outer ones shorter and weaker, less than three times the segments. Head light yellow.

Cervical sclerites, pronotum and pretergites light yellow. Mesonotal praescutum with four fulvous yellow stripes that are narrowly bordered by brown, the central dark line single, becoming obsolete before the suture, pseudosutural foveae black, triangular; scutum fulvous yellow, each lobe with two brown lines, the outer one darker; scutellum obscure yellow; postnotum yellow, the anterior mediotergite and posterior pleurotergite light gray pruinose; setae of praescutal interspaces and scutum sparse but very long and erect. Pleura with a broad white longitudinal stripe, bordered both above and beneath by a narrower pale brown stripe, dorsopleural region light yellow. Halteres with stem yellow, knob weakly darkened. Legs with fore and middle coxae weakly darkened, posterior pair and all trochanters yellow; remainder of legs yellow, tibiae with a darkened ring at near one-third the length; tips of tibiae and individual tarsal segments darkened; all leg segments with abundant very long erect setae, light yellow, darkened on the patterned rings.

Wings pale yellow, restrictedly patterned with brown, including origin of *Rs*, Sc_2, outer half of *Rs*, cord, and small marginal spots on all veins from Sc_1 to *2nd A*, lacking on R_5, the latter vein weakly seamed with brown; veins yellow, dark brown in the patterned areas including the costal fringe. Venation: Sc_1 ending opposite R_2, Sc_2 far retracted, about opposite two-fifths *Rs*; R_{2+3+4} nearly three times the basal section of R_5; *m-cu* before fork of *M*; vein *2nd A* nearly straight.

Abdomen yellow, both tergites and sternites with conspicuous brownish black marginal dashes. Ovipositor with valves very long, slender, bases of hypovalvae darkened. Male hypopygium with two simple dististyles, the outer longer, appearing as a narrow blade with the tip narrowly obtuse; inner style about two-thirds as long, the narrowed tip acute and blackened, with a few long setae, base dilated, with several pale setae. Phallosome with gonapophyses blackened, conspicuous, appearing as gently curved horns that narrow into long spines, outer margin before apex with a few microscopic spinules, inner border near base with a strong recurved spine; inner elements of phallosome very small and inconspicuous.

Habitat: India (Assam). *Holotype:* ♂, Umbaso, Mikir Hills, United District of Mikir and North Cachar Hills, 2,300 feet, April 26, 1960 (Fernand Schmid). *Allotopotype:* ♀, pinned with type. *Paratype:* ♂, Phaiphengmun, Manipur, 2,157 feet, August 29, 1960 (Fernand Schmid).

Erioptera (*Psiloconopa*) *hirsutissima* is told from all other known members of the subgenus by the unusual development of setae on the legs. The open cell M_2 further distinguishes the fly from somewhat similar regional species of the subgenus *Ilisia* Rondani, including *Erioptera* (*Ilisia*) *asymmetrica* Alexander (*indica* Senior-White).

Erioptera (Psiloconopa) sparsiguttula, n.sp.

Allied to *areolata*; mesonotum gray, praescutum vaguely lined with darker; wings yellowed, restrictedly patterned with brown spots; male hypopygium with a single three-armed dististyle, the intermediate arm with a small lateral spur.

Male: Length about 4 mm.; wing 4 mm.

Rostrum brown; palpi dark brown. Antennae with scape and pedicel dark brown, flagellum yellowish brown. Head brownish gray.

Pronotum brownish yellow, clearer yellow laterally and behind. Mesonotol praescutum gray, the interspaces vaguely and narrowly darkened, each with a row of small black setae; tuberculate pits black, pseudosutural foveae castaneous; posterior sclerites of notum gray. Pleura brownish gray, restrictedly variegated with yellow, most evident on the metapleural region and dorsopleural membrane. Halteres brownish yellow. Legs with coxae and trochanters yellow; remainder of legs obscure yellow, outer tarsal segments infuscated. Wings yellowed, more saturated in the stigmal region; a restricted pattern of small brown spots at origin of Rs, Sc_2, tip of Sc_1 and R_2 and more diffusely at ends of veins R_{1+2} and R_3; cord and outer end of cell *1st* M_2 more vaguely clouded; veins brownish yellow, darker in the patterned areas. Venation: Sc_1 about opposite R_2, Sc_2 at near two-fifths the length of the long straight Rs; R_{2+3+4} more than twice R_2; M_{3+4} shorter than the sinuous M_4; *m-cu* shortly before fork of M; vein *2nd A* straight.

Abdominal tergites and hypopygium light yellow, sternites still paler. Male hypopygium with the tergal lobes heavily blackened, low, separated by a broad V-shaped emargination. Basistyle elongate, the apical lobe pale, about twice as long as broad, with a smaller lobule at its base. Dististyle single, with three arms, the outer arm or style a slightly curved blade that narrows into an acute spine; inner arm of style a broad flattened blade, the apex slightly more expanded, all angles obtuse; intermediate arm a straight darkened spine that is about one-half as long as outer arm, at near midlength with a small lateral spur. Phallosome with lateral apophyses appearing as slender curved spines, subequal in size and shape to the outer dististyle, near mesal end with a small erect black spine that curves slightly toward the midline.

Habitat: Northeastern Afghanistan. *Holotype:* ♂, Chanlacha, near Kunduz, altitude 590 meters, October 11, 1958 (E. I. Coher).

The present fly is related to *Erioptera* (*Psiloconopa*) *areolata* (Siebke) and various other allied species in the western Palaearctic region, including *E.* (*P.*) *intermedia* Bangerter, *E.* (*P.*) *spinosa* Neilsen, *E.* (*P.*) *subalpina* Bangerter, and *E.* (*P.*) *vicina* Tonnoir in Europe, *E.* (*P.*) *iranica* Alexander and *E.* (*P.*) *multiserrata* Alexander in the western Himalayas, and some additional species in eastern Asia and in western North America. It differs from all these species in the distinctly patterned wings and in hypopygial structure.

Erioptera (Teleneura) ctenophora, n.sp.

General coloration of thorax brownish black; head light silvery gray; halteres yellow; legs brown, the color produced in part by abundant vestiture; wings strongly darkened, the cord lying immediately before midlength; male hypopygium with outer dististyle expanded outwardly, the margin with a double row of about twelve strong spines; inner style a narrow yellow blade; phallosome including straight blackened apophyses and a conspicuous fanlike central structure that bears many flattened scales.

Male: Length about 3.6 mm.; wing 4.2 mm.; antenna about 0.8 mm.

Female: Length about 4 mm.; wing 4.2 mm.

Rostrum and palpi black. Antennae black throughout, all flagellar segments distinct, shorter than their longest verticils. Head light silvery gray.

Thoracic dorsum dark brown to brownish black, the lateral borders, including the praescutum, scutal lobes, parascutella and mediotergite more yellowish brown; setae of scutum and praescutal interspaces black, erect, those of the scutum longer. Pleura brownish black, ventrally more yellowed, most evident on metapleura and meron. Halteres yellowed, knob clearer yellow. Legs with fore coxae and trochanters brownish black, of middle and hind legs yellow; remainder of legs brown but appearing brownish black from the abundant vestiture that includes setae and very narrow scales. Wings strongly darkened; veins darker brown; macrotrichia on all longitudinal veins, brownish black, conspicuous. Venation: Cord immediately before midlength of wing, all outer veins long and generally parallel to one another; R_{2+3+4} about two-thirds *Rs*; vein *2nd A* elongate, only slightly sinuous.

Abdomen, including hypopygium, dark brown to brownish black. Male hypopygium with the dististyles slightly subterminal, outer lobe of basistyle with four powerful yellow fasciculate setae. Outer dististyle expanded on outer half, the apex with a double row or narrow crown of about a dozen strong blackened spines or elongate pegs, the outermost more acute; inner style a narrow yellow blade. Phallosome including blackened straight apophyses and a conspicuous depressed-flattened fanlike structure that is covered with many flattened scales that are applied shinglelike, outwardly these becoming smaller and more separated.

Habitat: India (Assam). *Holotype:* ♂, Rumkheng, United Khasi-Jaintia Hills, 5,500 feet, March 24, 1960 (Fernand Schmid). *Allotopotype:* ♀, pinned with type.

Erioptera (*Teleneura*) *ctenophora* is most similar to species such as *E.* (*T.*) *fusca* de Meijere, *E.* (*T.*) *melanotaenia* Alexander and *E.* (*T.*) *pennigera* Alexander, differing conspicuously in hypopygial structure, particularly the outer dististyle and phallosome.

Erioptera (Teleneura) lushaiensis, n.sp.

Mesonotum brownish yellow, sides of praescutum light brown; rostrum and antennae black; anterior vertex silvery white, with white setae; thoracic pleura dark brown with a broad ventral yellow stripe; knobs of halteres brownish black; legs yellow, ends of the individual segments not darkened; wings tinged with brown, inconspicuously patterned with darker brown and yellow, not forming distinct rows of spots along the veins beyond cord; R_{2+3+4} long, subequal to Rs.

Female: Length about 3.2 mm.; wing 3.5 mm.

Rostrum and palpi black. Antennae black throughout; flagellar segments long-oval, shorter than the verticils. Head darkened posteriorly, the front and anterior vertex silvery white with short white setae.

Cervical region obscure yellow above, darker beneath. Pronotum dorsally brownish yellow. Mesonotum brownish yellow, the sides of praescutum narrowly light brown. Pleura dark brown, with a broad ventral longitudinal yellowed stripe extending from behind the fore coxae to the base of halteres; dorsopleural region paler brown. Halteres with stem yellow, knob brownish black. Legs with fore coxae and middle coxae and trochanters brownish black, posterior pair yellowed; remainder of legs light yellow without darkening at ends of the individual segments; legs with very long slender scales additional to the setae. Wings tinged with brown, inconspicuously patterned with darker brown and yellow; darker brown spots along costa and marginally at ends of veins, lacking on R_5 and M_{1+2}, the costal series alternating with yellow costal interspaces; a weak darkening over cord, with scarcely indicated vague clouds on disk; veins yellow, pale brown in the darkened areas, the trichia darker. Venation: Sc_1 ending about opposite two-fifths R_{2+3+4}, Sc_2 before the level of fork of Rs; R_{2+3+4} very long, subequal to Rs; R_{2+3} nearly perpendicular, longer than R_2; cord shortly before midlength of wing, the outer veins long, extending generally parallel to one another.

Abdomen black. Ovipositor with cerci horn yellow, the bases darkened, conspicuously compressed-flattened, strongly upcurved to the acute tips.

Habitat: India (Assam). *Holotype:* ♀, Thingsat, Lushai Hills, Mizo District, 3,500 feet, September 10, 1960 (Fernand Schmid).

The most similar species is *Erioptera* (*Teleneura*) *annandaleana* Alexander (*punctipennis* Brunetti, preoccupied) which differs in the pattern of the wings and in the details of coloration of the head, antennae, halteres and wings.

A NEW SPECIES OF THE SUBGENUS *IRON* FROM MEXICO (EPHEMEROPTERA: HEPTAGENIIDAE

By JAY R. TRAVER[1]

The specimens herein reported were sent to me several years ago by Dr. Lewis Berner of the University of Florida, Gainesville, Fla.

Epeorus (Iron) metlacensis, n. sp

Allied to *Epeorus (I.) hesperus* (Banks), differing from that species by reason of the abdominal markings as well as by the dissimilar fore claws of the male imago. Like *hesperus, metlacensis* belongs in the *albertae* group of this subgenus.

Male imago (holotype). Body 12 mm.; fore wing 13 mm.; fore leg 13 mm. Head light reddish brown; narrow black markings anterior to ocelli and along anterior margin of frontal carina. Pedicel of antenna black in apical half; filament reddish brown. Large eyes, contiguous apically, mostly obscure vertex and occiput of head; however, occiput appears black-margined posteriorly. Thorax reddish brown. Anterior margin of pronotum, a somewhat crescent-shaped mark at middle of posterior margin, and a stripe extending down on to fore coxa, blackish. Narrow black median stripe and narrow lateral line anterior to wing roots, on mesonotum; scutellum smoky brown tinged strongly with reddish. Metanotal scutellum similar in color to that of mesonotum; area directly preceding it brighter reddish brown with narrow dark transverse markings. Black streaks on pleura anterior to wing roots, before and behind leg bases; black markings on coxa and trochanter of mid- and hind legs. Narrow black markings at posterior borders of meso- and metasterna.

Legs pale reddish brown. Deep brown median and pre-apical bands and narrow dark basal pencilings on all femora; median bands tend to form a dark spot. Fore femur approximately ¾ of tibia. Fore tibia black at apex; narrow dark transverse line at "knee" on all tibiae. Tarsal joinings and claws dark reddish brown; fore tarsus shaded with smoky apically. *Claws of fore tarsus dissimilar,* one sharp-pointed, one blunt; first three segments subequal to each other. See Fig. 4. One fore leg of holotype missing. Legs originally mounted in Hoyer's but had to be remounted; in this process segments 3 and 4 of remaining fore leg were lost. Data cited above taken previous to the original mount. Claws and distal segment as well as the two basal segments still present on type slide.

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[1] University of Massachusetts, Amherst, Mass.

Wings hyaline. Venation of fore wing light reddish brown, paler in anal area. Costal space before humeral cross vein faintly purplish when first studied, purple tinge no longer noticeable. Cross veins distinct, somewhat heavier than longitudinals; stigmatic area opaque whitish. Humeral cross vein widely black at subcosta-radial end, narrowly so at costal margin, giving the effect of a black comma-shaped mark, its tail on costal margin. Before bulla, eight cross veins (wide space between seventh and eighth); three between bulla and stigmatic area; circa 12 stigmatic veins, most of which are upright or but slightly oblique. At bulla, three somewhat crowded cross veins in subcostal and also in radial space. Veins in hind wing paler, cross veins prominent only in anterior half; faintly darker area at extreme base.

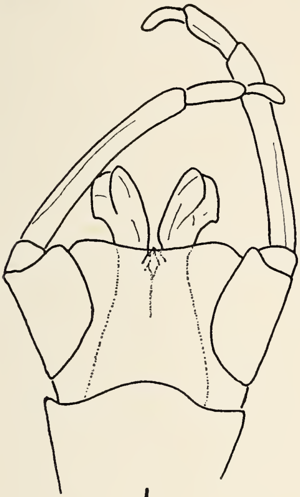
Basal and middle segments of abdomen yellowish translucent, apicals reddish brown, opaque. Continuous black median streak dorsally on tergites one thru eight, wider in anterior half of each tergite where it encloses a very narrow pale median line; on last two tergites, reduced to a very narrow median streak. Posterior margins of tergites one thru seven blackish, this band continuous laterally on two thru seven with an oblique black streak surrounding a pale spot at stigma and extending forward from this spot along pleural fold, as in *hesperus*. In addition, an oblique grayish brown streak on all tergites except the last two, midway between median line and pleural fold. Sternites pale yellowish; dark gray mid-line, faint except over ganglionic areas, widest on sternite one. Tails yellow, very narrowly darker at joinings. Genitalia yellowish with faint reddish tinge; for details of structure, see figs. 1, 7 and 8. Note the small spines (spinules?), on the larger central ones, which seems to be a distinguishing feature separating this species from others of the same group which have been heretofore described.

Male paratype. Similar to holotype, except as indicated. In one fore wing, five and an incomplete sixth cross vein before bulla, in the other fore wing seven in this area; in each wing, 11 stigmatic cross veins. Abdominal markings rather more prominent. Penes as in Figs. 5 and 6. Note apparent absence of any lateral spine-like extensions on these structures.

EXPLANATION OF PLATE I

All figures are of *Epeorus* (*Iron*) *metlacensis* n. sp. Fig. 1, Genitalia of holotype male. Fig. 2, Head of presumed nymph. Fig. 3, Claw of presumed nymph. Fig. 4, Claw of the fore leg, male imago. Fig. 5, Details of spines on penes, paratype male. Fig. 6, Penes of paratype male. Fig. 7, Details of spines on penes, holotype male. Fig. 8, Penes of holotype male.

TRAVER PLATE I



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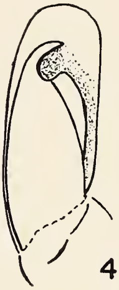

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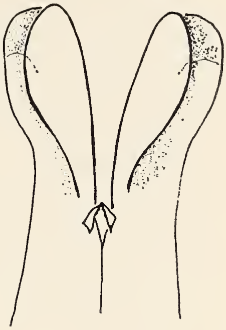

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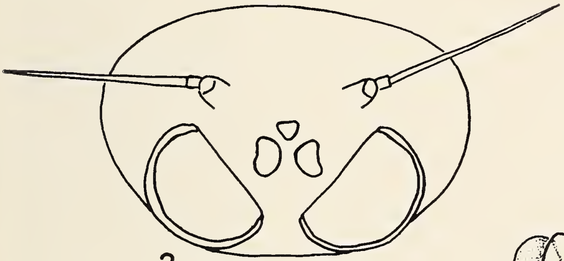

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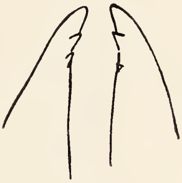

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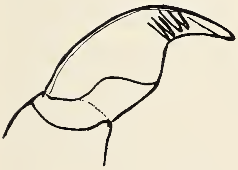

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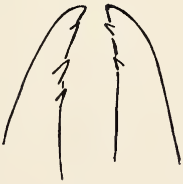

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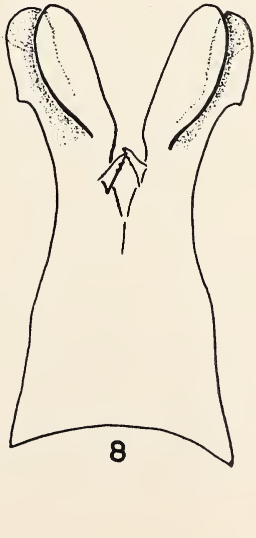

8

Female imago (allotype). Body 13 mm.; fore wing 15 mm. Differs from male, in addition to usual sexual dimorphism, as follows. Posterior margin of head, streak from median ocellus to posterior margin, and lateral streaks between eyes and lateral ocelli, dark brown. Thorax somewhat ruddy. Venation of fore wing darker and more conspicuous than in male; stigmatic area faintly pink-tinged. Humeral cross vein not paler toward costal margin. Mid-dorsal line on abdominal tergites more prominent, does not enclose a paler central line. Oblique lateral streaks reddish brown, more extensive, so that entire dorsal portions of tergites three thru six appear suffused with a reddish tinge, leaving paler areas between dark mid-line and inner margin of oblique streak on each side; on three, these pale areas in anterior half of tergite only, somewhat square in shape; on four thru seven, pale areas triangular, base of triangle on anterior margin, apex not attaining posterior margin. Tergite two largely dark gray with reddish tinge, except for narrow pale anterior margin and pale lateral area anterior to dark line which encloses whitish spot at stigma. Dark midventral line wider and more pronounced, not noticeably darker at ganglionic areas; widest on sternite seven, where it forms a butterfly-shaped area around egg valve.

Collection Data: *Holotype*—Male imago. Metlac, Mexico, 25 Dec., 1940; H. Hobbs, Collector. "Clear swift stream at Metlac, State of Orizaba? Origin of stream in snowfield of Mt. Orizaba. Very cold water. Late in P.M., just before dark they (the mayflies) emerged from rapids by the thousands." The above quoted from field notes by Dr. Hobbs. Specimen in private collection of J. R. Traver. *Allotype*—Female imago. Same data as above. In private collection of J. R. Traver. *Paratype*—Male imago. Same data. In collection of Dr. Lewis Berner.

A subimago male is included in this material sent to me by Dr. Berner. Similar to imago, except for smoky red-tinged wings. As in the paratype, the spine-like lateral extensions on the penes, usually found in males of this group, are apparently absent.

Discussion. The *albertae* group of the subgenus *Iron* now includes five species, of which four have been described previously; all are from North America, but only *metlacensis* occurs south of the United States. *Epeorus* (*I.*) *albertae* McDunnough, 1924 and 1929, is known from Alberta, Wyoming and Montana. The type specimen of *E.* (*I.*) *hesperus* (Banks), 1924, a single female, was taken in Washington state. *E.* (*I.*) *sancta-gabriel* Traver, 1935, from California, has recently been synonymized with *hesperus* (Edmunds and Allen, 1957): this possibility was noted in the original description of the species. *E.* (*I.*) *youngi* Traver, 1935, is considered a synonym of *albertae*. The other two species described heretofore are: *lagunitas* Traver, 1935, also from California; and *dulciana* McD., 1935, from British Columbia. The new species *metlacensis* differs from all others of the *albertae* group by reason of: (1) the much more extensive abdominal markings; (2) the small spines (spinules) on the larger central spines of the penes; (3) the dissimilar fore claws of the adult male. The slight crowding of cross veins at the bulla may also be distinctive. General shape of the penes bears much resemblance to these structures in other species of the group, but the lateral spine-like extensions, while present but minute in the holotype, are much less conspicuous, while in the paratype and the subimago males mentioned above are either lacking or still more minute. The new species likewise is considerably larger than any of the others named above.

Nymphs, which by reason of their large size, body structure, dissimilar claws visible within the segmented fore tarsus of a mature male nymph, and markings of thorax and abdomen, are presumed to be those of *metlacensis,* are herewith described.

Head capsule distinctly widened anterior to the eyes and narrowed posteriorly. See Fig. 2. Four blunt teeth or pectinations near tip of each claw, on side of claw, not on lower margin. See Fig. 3. In addition to the thick fringe of long fine hairs on tibiae and tarsi, two irregular rows of more or less parallel short stubby spines on ventral surfaces of each of these segments, best developed on the third leg. Tip of flange at apex of each femur well developed but rather blunt. Femora likewise fringed with long hairs but lacking the blunt spines. Posterolateral spines on abdominal segments well developed (might be termed intermediate between those of *vitreus* and of *longimanus*). Gills of first and seventh pair do not approach one another beneath body of nymph.

General body color dark reddish brown, paler ventrally. Between bases of antennae and backward toward ocelli an irregularly circular darker area enclosing a paler one; slightly darker shading and submedian bands extend backward from ocelli and between eyes. Black markings on pronotum at middle of anterior margin; black spot in posterolateral angle. Black streaks above and behind leg bases on thoracic pleura. Customary black spot near middle of femur, with pale streak extending medially toward base, a shorter triangular streak toward apex, and medial transverse streak. Mature nymphs show considerable brown freckling on upper surfaces of femora, also black pre-apical band. Middorsal black streak on abdominal tergites; reduced to a spot on tergite one, and to a narrow line on nine and ten; on each side of this, on ten, an oblique black streak. On intermediate tergites, this dark mid-streak is more or less triangular, base of triangle on anterior margin. Posterior margins very narrowly blackish. A fully mature female shows also a black spot on anterior margin, near base of gill; faint indications of a dark oblique streak from this dark spot. A fully mature male nymph shows the oblique lateral streaks well developed on tergites three through eight; background color of six and nine distinctly yellowish, this color forming conspicuous patches on each side of mid-dorsal line on tergite six. Pleural fold dark brown, this color continued ventrally as a dark brown lateral margin of the sternites. Ganglia faintly blackish on seven, eight and nine; indistinct mid-ventral line; narrow dark transverse marks at mid-ventral line on three thru six. Immature nymphs show on each side of the mid-dorsal line of tergites a brown submedian patch closely surrounded by a paler area. Ventrally, an indistinct darker streak parallels the pleural fold on basal and middle sternites; this widens to form an antero-lateral dark triangle on each side of adjoining pleural fold, on sternite nine. Lamellate portion of gills quite large, extending backwards over approximately two and one half segments beyond point of origin. Wide brown band on outer margin; inward from this a pale area followed by a wide purplish portion which occupies more than one half of each gill. A median double brown line in basal half to two thirds indicates position of tracheal trunk. Tails of nymphs pale reddish brown, deeper in color near base in mature forms; very narrowly paler at joinings.

More than 30 nymphs of both sexes, several of these nearly mature, were taken at Metlac, Mexico, on December 26, 1940, by Dr. Hobbs. Presumably the information previously given under the account of the imagos in regard to environmental conditions at the site of collections holds true also for the nymphs.

Nearly mature nymphs of the subgenus *Iron* which by reason of the abdominal markings are presumably *Epeorus* (*Iron*) *metlacensis* were taken in Costa Rica, San Jose, 12 mi. N. of San Isidro del General (Pan. Amer. Hwy.), on July 22, 1962, by G. G. Musser. Still others, all immature, which may represent a different species, are from Jajalipa, Mexico, in the Canadian Zone, at 9,000 ft., taken on July 11, 1955 (collector not indicated.) Both of the above mentioned groups of nymphs are in the entomological collection of the University of Utah, and were sent to me for examination.

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THE USE OF SAND GRAINS BY THE PAVEMENT ANT *TETRAMORIUM CAESPITUM* WHILE ATTACKING HALICTINE BEES

By Norman Lin[1]

This paper is an account of an unusual method of attack used by the pavement ant, *Tetramorium caespitum,* against a primitively social halictine bee, *Lasioglossum* (*Dialictus*) *zephyrum.* The pavement ant is omnivorous but lives mainly on a diet of insects (Morley, 1953). The nests of the bees were located on a sandy footpath in the Parade Grounds, a sandlot ballfield in Brooklyn, New York. The nest burrows open by a neat circular hole about two millimeters in diameter at the surface of the ground. The entrance of the nest is frequently guarded by a bee within the burrow which plugs the entrance with its head. On being disturbed by natural enemies such as mutillids or by some object held by the observer, the bee usually (if the disturbance lasts long enough) turns around and plugs the hole tightly with its abdomen. The following records are based primarily upon a single observation, but such behavior was noticed twice—once during the summer of 1957, and more completely during the spring of 1958. The bees measure about 7.5 mm. and the ants about 4 mm. in length.

On July 21, 1957, between 7:10 A.M. and 8:10 A.M., a number of ants were observed around two adjacent bee nests. Two ants entered one of the nest burrows from which a bee had flown seconds before. Two bees flew to the entrance, one after the other, and disappeared almost immediately into the burrow. The ants remained clinging to the wall of the burrow. Some ants then picked up grains of sand (some of which were almost as large as the ants) carried them to the nest and dropped them in. At one point sand was also dropped on the head of a bee blocking the burrow. When the nests were again examined between 10:15 A.M. and 10:45 A.M. the ants were gone from the area.

On June 2, 1958, at 9:30 A.M., about eight ants were engaged in dropping grains of sand into a bee's nest. The head of a bee could be seen nearly filling the burrow slightly below ground level.

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[1] Department of Zoology, The University of Kansas. I am indebted to Dr. C. D. Michener of The University of Kansas for his constructive criticism of this paper. I wish to thank him also for identification of the bee and Dr. M. R. Smith of the Smithsonian Institution for identification of the ant.

Each ant walked to the rim of the burrow with a grain in its mandibles, extended its head over the rim and dropped the grain which fell on the bee's head. The sand came from a source generally 25 millimeters or more from the nest. The size of the sand grains was quite variable, from considerably larger to considerably smaller than an ant's head. One ant, coated with fine light sand, had meantime been lying motionless with its head protruding slightly over the rim of the burrow. This ant was at first thought to be dead and was moved a little to verify this impression. The ant proved, however, to be very much alive and immediately returned to its former position. This ant will be referred to hereafter as the guard ant.

A large sand grain lying near the nest entrance had been pushed into it and blocked the entrance. There were small openings between the rim of the burrow and the sand grain plugging it. An ant placed a smaller grain in one of these openings. This grain would certainly have fallen within the burrow, if not placed in the proper position. Another grain was similarly placed. Presently the bee came up to the surface, and with a thrust of its head dislodged the entire delicate mass which fell into the burrow.

Ants again commenced to drop in small grains, at a rate of perhaps one every few seconds, while others in one or more small groups of about two or three jointly carried up larger grains and debris, which they left standing next to the nest entrance. The bee approached the surface of the ground with a small sand grain held in its mandibles. When the bee was near the surface, the guard ant, which had maintained its previous position the entire time, moved toward it "aggressively," and the bee withdrew within the nest. The bee blocked the burrow just below the surface with a dorsal portion of its abdomen, and the ants then placed grains on the bee's abdomen. The bee apparently moved deeper within the burrow for the mass of sand grains again fell inside.

The ants again plugged the nest entrance and the bee again cleared it with a quick thrust of its head. When the guard ant, which up till now remained at its post, went about 10 millimeters from the nest entrance, the bee began removing sand grains from within the nest, and placed them outside the nest entrance. The bee did not work unhampered, for each time its head appeared above the surface of the ground in removing a grain, some ant would quickly move toward it, and the bee always responded by withdrawing rapidly within the nest. The activity of the ants began to decrease at about the time the guard ant left the nest. This decreased activity was expressed in the following ways:

1. Fewer ants participating.
2. Decrease in the speed of movement of the ants.
3. The trip to the nest with a sand grain took on a more haphazard appearance. Ants no longer walked up directly or almost directly to it as earlier but rather walked in wrong directions and circled more about the area before reaching the nest.
4. A large reduction in the rate of grain dropping—a consequence of the three previous factors.
5. Generally, an apparent decrease in the size of the grains dropped.

After the guard ant left, one or two ants occasionally approached the nest and "peered" in, but for the most part the nest was "unguarded" by ants. The following detailed records were made after the diminution of ant activity recorded above: Nine grains of sand and a small piece of wood were dropped into the nest burrow, with intervals between the times of dropping varying from approximately 4 to 73 seconds and with a mean of 30 to 32 seconds. After an interval of about 25 seconds a large grain was placed next to the nest entrance, followed in about 12 seconds by the dropping of a small grain. In about 50 seconds a piece of leaf was placed across the nest entrance which it almost entirely covered. A large grain about three times as large as the head of the ant dragging it was placed over an opening between the stiff piece of leaf and the rim of the burrow. Placing the grain in position took between 15 and 20 seconds. The ant then removed it and plugged a still larger gap, which appeared to the observer to be a more efficient use of the grain. The first opening was plugged with a large grain about 40 seconds later. The bee then came to the surface, knocked both grains down and pushed the leaf fragment aside. It again came to the surface of the ground and raised its head above it. An ant came close but did not attack or make "threatening" moves as ants had done earlier. The bee did not withdraw on the ant's approach. About a minute later a large and then a smaller grain were placed next to the nest entrance. The bee's head was protruding above the surface of the ground the entire time. Another ant came close and the bee withdrew into the nest. The bee climbed about three-quarters outside of the burrow after about a minute without ant activity, only to withdraw rapidly when an ant passed. The bee again climbed about three-quarters outside of the burrow and pushed the sand grains placed around the rim of the burrow further back. An ant approached and the bee rapidly entered the nest. A two-minute period passed without the intervention of the ants, and in that time the bee slowly emerged and flew away.

During the estimated fifteen minutes that the bee was away, no grains were dropped into the nest, though one or two ants came up to the entrance and stuck their heads over the rim. This was by far the longest period of time that grain-dropping ceased. About two minutes after a bee returned to the nest, two or more ants came to the rim. One of them crawled slowly down the vertical wall of the burrow until it was almost completely inside. It seemed to slip, and fell within. A struggle could be seen in the dark, after which the ant came speedily out.

A bee again left the nest, which then became partially covered with the leaf particle which was blown across it by the wind. An ant approached the nest, touched the leaf particle, and left with great rapidity. It started on its way back after picking up a small grain approximately 13 millimeters from the nest. Its course back was not a straight one, being characterized by the erratic movements mentioned earlier. After reaching the nest, the ant dropped its grain within. Several more were so dropped, but soon dropping ceased, and no more activity took place in nearly one half hour of continuous observation.

The behavior described occurred over a period of about 90 minutes. There was no evidence that more than one bee was associated with the nest during the period of observation; however, the nest was partially dug up on the following day and two adult bees were taken from it.

Discussion

According to Wheeler (1926) nearly all ants in the presence of some substance that they cannot remove (such as a strong-smelling liquid) throw pellets of earth or any other debris on the substance, sometimes in sufficient amount to bury it completely. The present situation definitely appeared to be an aggressive one, and consequently different from the above in this as well as in other respects.

The grains of sand were, it appeared, used as weapons by the ants, hitting the bee when dropped. This seemed to have the effect of causing the bee to withdraw a bit deeper into the burrow. Larger grains, some smaller grains, and debris were used for nest plugging. These large grains tended to be deposited around the rim of the nest burrow and placed in the entrance after a barrage of small grains. When the nest entrance was clear and when grain dropping was interrupted, the bee was prevented from leaving or removing grains by the guard ant. If the bee attempted either, the guard ant moved toward it and the bee withdrew into the nest. When the guard ant left, the bee was free to leave the nest, to remove grains dropped within, and to clear grains around the entrance.

The guard ant appeared to be the key figure in the ants' operation. Her function seemed two-fold.

1. Her specific job of keeping the bee within the nest.
2. Her presence, which indirectly seemed necessary for the most efficient (and perhaps continued) activity of the other ants.

It appeared to the observer that the decreased activity and "aggressiveness" of the ants after the guard ant left was followed by a corresponding increase of the bee's "boldness" in the presence of the ants.

Since the ants were, it appeared, unsuccessful in their operation, what the outcome would have been if successful is unknown. Dropping ceased when the bee left the nest except for a short burst of activity the second time, probably associated with the piece of leaf blown across the nest entrance. It appeared that the ants were attempting to trap the bee within the nest and not just plug up the nest. Alternatively, one might suppose that the ants were merely closing a hole in response to its form or odor and that the aggressive component of their activities arose somewhat independently when a bee happened to be perceived nearby. Perhaps ants use bees as food. This is supported by the following observation. On July 10, 1957, between 7:00 A.M. and 7:50 A.M., an ant was holding a dead *L. zephyrum* on top of an almost completely plugged nest entrance. On the preceding day this nest was clear and had a bee guarding its entrance.

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A. S. PACKARD'S ANNUAL RECORD OF AMERICAN ENTOMOLOGY, 1871–1873

By Ralph W. Dexter[1]

Alpheus Spring Packard, Jr., student of Louis Agassiz, was an eminent entomologist in his generation of naturalists. His early life as a student and developing entomologist (1839–1864) has been traced by this writer in this journal (52: 57–66; 101–112. 1957). Packard was intensely interested in the literature of natural history in general and of entomology in particular. He was a founder (1867) and long the chief editor of the *American Naturalist* (see Amer. Nat. 90: 209–225. 1956). A portion of his diary for May, 1871, illustrates his preoccupation with entomological publications:

> "May 1, 1871. Began to write "Our Common Insects" a reprint mostly of my insect papers in the *Naturalist*. May 8. Letter from Editor of *Independent*. Wants me to edit Scientific Column of the *Independent*—$12 a week. Wants me to try it for a month. I think I will. Letter from Prof. Henry (Joseph Henry) wanting me to suggest or prepare a "Manual of Collecting Insects." I think I will."

That same year he conceived and organized an annual summary of entomological literature.

In the 4th–6th Annual Report of Trustees of the Peabody Academy of Science at Salem, Massachusetts, there appeared a bibliographic series known as "Record of American Entomology for the Year." These annual reviews were prepared by A. S. Packard, Jr., for the years of 1871–73. Each installment was published during the year succeeding its coverage (i.e. 1872–74). These reports averaged 146 pages each and were as complete as Packard and his associates were able to make them. In the first issue covering the published entomological literature of 1871, Packard, in addition to being editor, prepared the bibliographies for Hymenoptera, Heterocera, and Myriopoda. Edwin Burgess prepared the Rhopalocera and Diptera. G. H. Horn prepared the Coleoptera, while Cyrus Thomas compiled the Orthoptera. P. R. Uhler compiled Hemiptera and Neuroptera. Finally, J. H. Emmerton prepared the Arachnida. Note that the arachnids, centipedes, and millipedes were included with the insects. In addition to the reference for each paper, brief notes were written on the contents, especially notations on the description of new species and of the use of figures in the publications.

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[1] Department of Biological Sciences, Kent State University, Kent, Ohio.

For 1872, these men continued their earlier assignments with the exception that Packard took over the task of compiling literature on arachnids in place of Emmerton.

In the third and last number covering the literature of 1873, S. H. Scudder prepared the sections on Rhopalocera and Orthoptera, H. Loew assisted Burgess with the Diptera, and Packard took over the section of Neuroptera. Packard essentially carried out on a limited scale a project which one of his colleagues, F. W. Putnam, had proposed to do for the entire plant and animal kingdoms. Putnam's proposal was quite similar to what is now known as *Biological Abstracts.* An account of his plan was published as an editorial in the 15 February 1963 issue of *Biological Abstracts,* written by this author.

In 1953, the Entomological Society of America undertook a project which, in essence, revived the work of Packard some 80 years earlier. A committee was appointed to study the problem of publishing a review of entomological literature. Volume I of this new series was published in 1956, with Edward A. Steinhaus as editor and Ray F. Smith as associate editor. This series has been called *The Annual Review of Entomology.* With Volume V, Steinhaus and Smith became co-editors, and beginning with Volume VIII, Ray Smith became the senior editor and Thomas E. Mittler became associate editor. These volumes are published by Annual Reviews, Inc., at Palo Alto, California.

Thus, the service to American entomologists established by A. S. Packard in 1871 has been continued after a long lapse of time. The efforts of Packard in this direction and of his colleague F. W. Putnam, in his proposal for a periodic compilation of biological literature, demonstrate the far-sightedness of these early American naturalists in the promotion of biological research through bibliographic services.

NOTES ON THE BUPRESTIDAE: PART IV WITH A NEW SYNONYM IN *CHRYSOBOTHRIS*

By G. H. Nelson[1]

Collections made during the past several years have yielded more biological information about some of our Buprestids. Thanks are due to Messrs. D. S. Verity and G. C. Walters for allowing the writer to make their collections known and to Mr. Hugh B. Leech, California Academy of Sciences, and to Professor J. N. Knull, Ohio State University, for checking specimens in their collections. The observations were made by the writer, unless otherwise stated.

Ancylotela tucsoni (Knull), 1938, Ent. News 49: 21, 22. This species was described from one pair and no host plant was mentioned. Two specimens were taken in the Tucson Mts., Ariz., Aug. 9, 1961, while beating *Acacia* sp. and another was taken while beating *Olneya tesota* Gray at Cavecreek, Maricopa Co., Ariz., July 3, 1964.

Acmaeodera griffithi Fall, 1899, Jour. N. Y. Ent. Soc. 7: 36. This species is usually out early in May but two were collected at Congress, Ariz., June 27, 1964, while beating *Acacia greggii* Gray.

Acmaeodera adenostomensis Knull, 1941, Ann. Ent. Soc. Amer. 34: 691, 692, pl. 1, fig. 4. This species was described from specimens recorded as from *Adenostoma fasciculata.* A fair series of this species has been collected over the past ten years during June and early July and the plant of choice in all these collections has been *Adenostoma sparsifolium* Torr. It appears that the latter plant may prove to be the host for this species.

Acmaeodera fattigi Knull, 1953, Ent. News 64: 144, 145. This uncommon species has been reared from dead limbs of *Acacia greggii* Gray, collected Feb. 4, 1962, at Mountain Springs, Imperial Co., E. of Jacumba, Calif. One male emerged on Aug. 9, 1963, and a female on July 17, 1964.

Acmaeodera junki Théry, 1929, Bull. Soc. Ent. Egypte, 115. This species emerged from the same material as mentioned above for *fattigi.* Emergence dates include: July 9–25, 1963; July 4, 1964.

Acmaedera hassayampae Knull, 1961, Ohio Jour. Sci. 61: 80. Specimens of this species emerged on June 29, 1962, from the

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[1] Department of Anatomy, Loma Linda University, Loma Linda, Calif.

Acacia greggii limbs mentioned above.

Poecilonota bridwelli Van Dyke, 1918, Ent. News 29: 53. In his revision of the genus, Evans, 1957, mentions that in Arizona the host plant is aspen and in California it has been collected on willow and aspen. Judging from the distribution of this species in Southern California, it seems unlikely that aspen serves as a host in that area. The writer, acting from suggestions by F. G. Werner and F. H. Parker, who told of several specimens emerging from cottonwood limbs, caged some living limbs of *Populus fremontii* Wats. with gall-like swellings from S. of Hesperia, mouth of Deep Creek, San Bernardino Co., Calif. Specimens of this species emerged as follows: May 11, 12, 17, 22, 1962. Other specimens were taken on the foliage of this plant near Oro Grande, same Co., during June and July, 1963 and June, 1964. At the same place and from the same plant, on June 14, 1964, one specimen was taken by F. M. Beer as it was ready to emerge from a six-inch limb and the writer cut another from its pupal chamber in the bark on a trunk.

Chrysobothris schaefferi Obenberger, 1934, *in* Junk (pub.) Coleopt. Cat., pt. 132:649. This species is recorded by Fisher, 1942, from Baja California, host unknown. New records include: one on *Cercidium floridum* Benth., 90 mi. S. of Mexicali and 26 mi. W. of San Felipe Highway, Baja California, Apr. 13, 1962, by the writer; one on *Acacia greggii* Gray at Mountain Springs, Imperial Co., Calif., July 1, 1961 (new record for California); two females emerged from *Bursera microphylla* Gray on Aug. 21 and 23, 1962, wood collected 5 mi. S. of Ocotilla Wells, San Diego Co., Calif. The last three collections were made by D. S. Verity.

Chrysobothris humilis Horn, 1886, Trans. Amer. Ent. Soc. 13: 99, 102, 103, pl. 6, figs. 169–172.

Chrysobothris cupreohumeralis Van Dyke, 1934, Ent. News 45: 65, 66. (NEW SYNONYMY)

The latter species was described from a unique "female" from El Paso, Tex. All specimens of *cupreohumeralis* that have been collected since then by the writer and his acquaintances have proven to be males. Sometimes these were taken on the same plants with *C. humilis,* the latter always females. The suspicions thus aroused that the two were merely dimorphic sexes of the same species were confirmed when Mr. Hugh Leech, who kindly examined the genitalia on the type of *cupreohumeralis,* found that it is, indeed, a male instead of a female. Thus, in *humilis* we have the most striking case of sexual color dimorphism among known North American *Chrysobothris.*

Chrysobothris biramosa biramosa (Fisher), 1935, Proc. Ent. Soc. Wash. 37: 117, 118. This species was described from a unique male collected in Skull Valley, Utah. At the time of Fisher's 1942 revision, the type was the only specimen known and nothing was known of it's habits. The writer and his family stopped in Skull Valley, Utah on July 16, 1962, and collected a short series of both sexes on *Atriplex confertifolia* (Torr. & Frem.). A pair was taken by D. S. Verity at Winterhaven, Imperial Co., Calif., July 1, 1962, on *Atriplex lentiformis* (Torr.). This is the first record for California. Two males, one immaculate, the other with faint indications of an apical spot were taken by the writer on *Atriplex* sp. at Woodruff, Navajo Co., Ariz., July 1, 1964. (First record for Ariz.) These compare favorably with topotypic specimens except for the lack of maculations.

Chrysobothris bicolor Horn, 1894, Proc. Calif. Acad. Sci. (ser. 2) 4: 328, 366, 367. One male was collected by D. S. Verity on *Acacia greggii* Gray, 5 mi. W. of Jacumba, San Diego Co., July 1, 1961. This is the first record for this species in California.

Chrysobothris smaragdula Fall, 1907, Canad. Ent. 39: 239, 240. According to Fisher, 1942, the host for this species is unknown. One was collected as it was running along the branch of a young *Quercus utahensis* (De Candolle) near Prescott, Ariz., June 30, 1964 and three others were taken near Globe, Ariz., June 8, 9, 1963, while beating *Mimosa* sp.

Agrilus restrictus Waterhouse, 1889, Biol. Cent. Amer., Coleopt. 3: 119, pl. 7, figs. 7, 7a. One female was collected at Copper Canyon, south end of the Huachuca Mts., Ariz., July 21, 1963, while beating *Rhus chlorophylla* Woot. & Standl.

Agrilus cavatus Chevrolat, 1838, Silbermann's Revue Entomol. 5:99. A pair of this species was taken on *Rhus chlorophylla* Woot. & Standl. at Copper Canyon, south end of the Huachuca Mts., Ariz., by G. C. Walters and another pair was taken by K. T. Nelson at the same place, Aug. 24, 1964, while sweeping grass and low herbs.

Agrilus duncani Knull, 1929, Ent. News 40: 270, 271. This species was described from a unique male from the Sierra Ancha Mts., Ariz., with no host plant information. It has been collected in good numbers on *Chrysothamnus nauseosus* var. near Portal, Ariz., Aug. 30, 1964, by G. C. Walters and E. of Coronado National Monument, Ariz., July 22–25, 1963, by the writer.

Agrilus wenzeli Knull, 1928, Ohio Jour. Sci. 34: 333, 334. One pair was taken E. of Globe, Ariz., June 8, 1963, while beating *Acacia greggii* Gray and a male was taken in Sixshooter Canyon, near Globe, June 9, 1963, on *Prosopis chilensis* (Molina).

Agrilus mojavei Knull, 1952, Ohio Jour. Sci. 52: 352, figs. 6, 7. This species was described from a unique male from poplar at Oro Grande, Calif. Several of both sexes emerged from infested living limbs of *Populus fremontii* Wats. between May 31 and June 13, 1963. The limbs were collected Mar. 11, 1963, S. of Hesperia, Calif.

Description of female—differs from male in being more robust and with first and second abdominal sternites convex at middle.

Length: 10 mm.; Width: 3 mm.

Allotype, female (writer's collection), Calif., San Bernardino Mts., mouth of Deep Creek, S. of Hesperia, G. H. Nelson, emerged from *Populus fremontii* Wats., June 3, 1963.

This species was placed next to *A. fisheriana* Knull at the time of description. When *fisheriana* was described, it was mentioned that it would run to *A. macer* Lec. in Fisher's 1928 key. At couplet No. 31 *A. mojavei* could go toward *macer* but also some specimens in the series at hand might take the opposite route and run to *A. populi* Fishr. On comparing *mojavei* with *populi,* it is found that they are quite similar, including male genitalia and host plant preference. It is therefore quite possible that *A. mojavei* Knull is most closely related to *A. populi* Fishr. It differs from *populi* in being more densely pubescent ventrally and in being more uniformly brassy-cupreous in color.

Agrilus masculinus Horn, 1891, Trans. Amer. Ent. Soc. 18: 295, 296. One male emerged on Apr. 19, 1953, from a redbud (*Cercis canadensis* L.) limb collected at Great Falls on the Potomac River, Md.

Agrilus shoemakeri Knull, 1938, Ohio Jour. Sci. 38: 99. This species was described from a unique male and so far it seems to have been rarely collected. One male which was kindly compared with the type by J. N. Knull, was collected while sweeping grass and low herbs in Madera Canyon, Santa Rita Mts., Ariz., Aug. 10, 1961, and one female was collected as mentioned below.

Description of female—similar to male but differs in being slightly more robust and with first and second abdominal sternites convex at middle.

Length: 7 mm.; Width: 1.75 mm.

Allotype, female (writer's collection), Ariz., 13 mi. N.W. of Nogales, Sept. 8, 1957, T. R. Haig.

Agrilus aeneocephalis Fisher, 1928, U.S.N.M. Bull. 145: 245, 246. A short series of both sexes was collected on *Mimosa* in Madera Canyon, Santa Rita Mts., Ariz., Aug. 4, 1961.

Agrilus huachucae Schaeffer, 1905, Bull. Brookl. Inst. Mus. 1 : 150. In his revision of the genus, Fisher, 1928, mentioned that Schaeffer collected the species from *Quercus*. A moderate series of both sexes was collected on the crowns and foliage of young wild sunflower plants at the mouth of Copper Canyon, south end of Huachuca Mts., Ariz., Aug. 13, 1961 and Aug. 24, 1964. Vigorous beating of the oak trees in the area yielded no specimens.

Agrilus santaritae Knull, 1937, Ent. News, 48: 39, 40. Since no biological information on this species was available at the time of description, it will be of interest to mention the collection of a small series of both sexes at Madera Canyon, Santa Rita Mts., Ariz., Aug. 5–10, 1961, by sweeping grass.

Mastogenius robustus Schaeffer, 1904, Jour. N. Y. Ent. Soc., 12:210. Several of this species were collected while beating *Quercus hypoleucoides* Camus as follows: Miller Canyon, Huachuca Mts., Ariz., July 17–23, 1963, Aug. 23, 1964, and Copper Canyon, south end of Huachuca Mts., July 21–24, 1963.

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A NEW SPHEGINA FROM NEPAL (DIPTERA: SYRPHIDAE)[1]

By F. Christian Thompson[2]

A unique new *Sphegina* is described from Nepal. This species is the first syrphid known to the author to have specialized postabdominal structures other than those of the genitalia on the tenth segment. The type is preserved in my collection.

Sphegina (Asiosphegina) hansoni, n. sp.

Head black, antennae orange. Thorax black, front four legs yellow, hind femora mostly black, hind tibiae brown with an apical yellow ring. Abdomen metallic bluish black except reddish basal third of third segment, second segment cylindrical and five times as long as wide. Male with fourth sternite and postabdomen highly specialized.

Male.—Head: completely black except orange frontal lunule and epistomal tip, sparsely white pollinose. Face deeply concave, epistoma projecting forward beyond the antennal base. Antennae completely orange with orange pile. Third antennal segment longer than the first and second segments together, flat on the dorsal surface and greatly convex on the ventral surface; thus the antenna fits neatly into the facial concavity. Arista orange, pubescent and about one and one-fourth times as long as the antenna.

Thorax: completely black except for yellow postalar calli and prosternum, grayish pollinose with very short and sparse white pile. Scutellum black, with short sparse white pile and with two thin crossed black bristles on the apex. *Legs:* Front four legs yellow except brown apical two tarsal segments. Hind legs with trochanter and basal one-fourth of femur yellow, with coxa and remainder of femur black, with tibia brown except for the base and a ring on the apical one-fourth yellow and with tarsus brown. Hind femur armed with two ventral rows of short black spines and a dorsal subapical black bristle. *Wings:* hyaline except all crossveins and tip of marginal cell clouded with brown. *Halters* and *Squamae:* orange.

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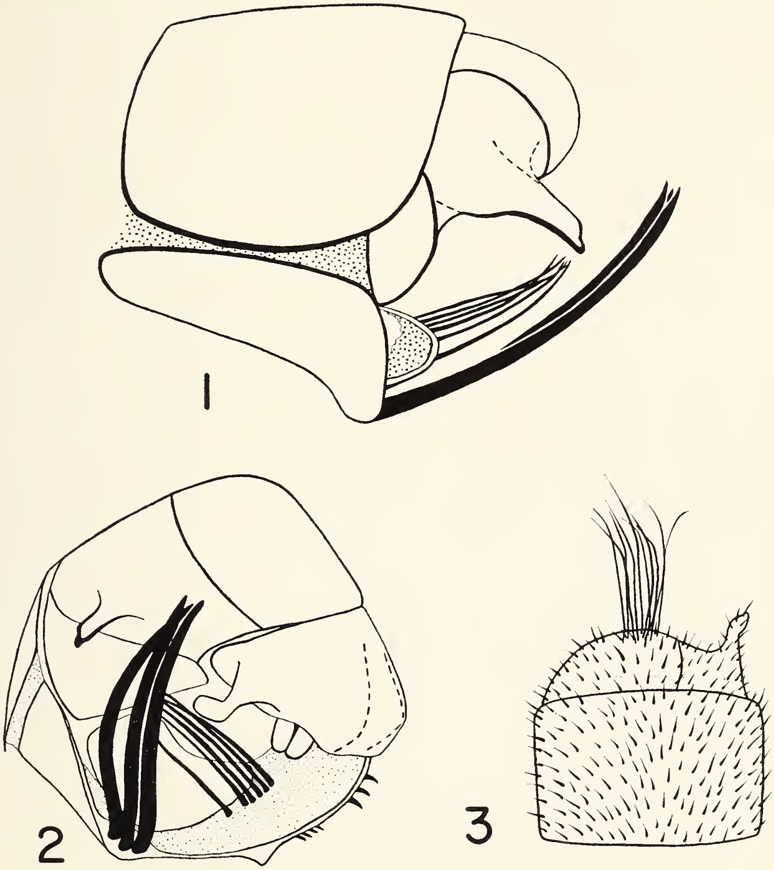
[2] University of Massachusetts, Amherst, Mass.

Abdomen: Dorsum metallic bluish black except reddish orange basal third of the third segment, with long golden pile on the first and second segments and shorter golden pile on the remaining seg-

THOMPSON PLATE I

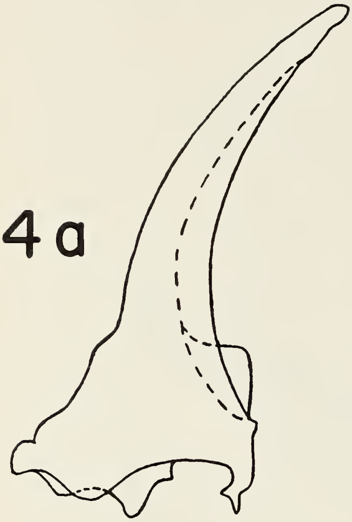


Tip of the male abdomen of *Sphegina hansoni,* n. sp. Fig. 1, Lateral view, left side with the tenth segment removed. Fig. 2, Caudal view. Fig. 3, Dorsal view.

EXPLANATION OF PLATE II

Styles of the male genitalia of *Sphegina hansoni,* n. sp. Fig. 4, Right style. Fig. 5, Left style. a, Dorsal view. b. Lateral outside view.

THOMPSON PLATE II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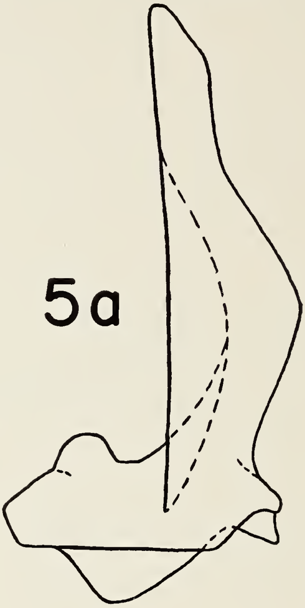
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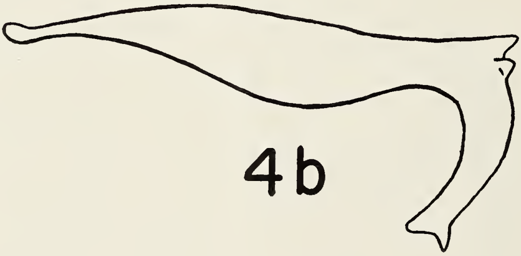
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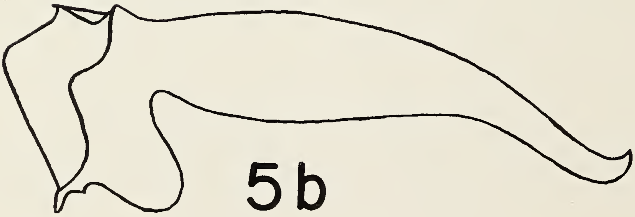
5b

ments. First segment with three black bristles on each side and with the lateral margins produced into large basal spurs. Venter black except orange third sternite, with golden pile. Third sternite reduced to a small oval plate about the size of the third antennal segment. Fourth sternite greatly produced ventrally and heavily armed. The armature consists of: three macrobristles whose bases are inserted medially on the posterior edge at the ventral-most point of the sternite; a small anteriorly directed tooth to the right of the macrobristles on the posterior edge; two sets of minute spines to the right of the tooth and also on the posterior edge; a row of six bristles dorsal to the tooth and inserted on the membranous area at the end of the sternite; and a sclerotized bursiform structure dorsal to the macrobristles. *Postabdomen:* black with golden pile. Eighth urite with a large pencil-like posteriorly projecting process. Ninth urite with a tuft of long golden pile posteriorly directed. Tenth urite with a large L-shaped process lateral to the cerci. Genitalia asymentric.

Holotype male.—NEPAL, Parewavir, 570 meters. 26 March 1957 (E. I. Coher and G. P. Joshi).

Discussion: This species because of the unusual structures on the postabdomen does not appear to be closely related to any known species. In appearance it approaches *bispinosa* Brunetti but differs on a number of points such as coloration of antennae and abdomen and the armature of the fourth sternite. *Hansoni* will run to *nitidifrons* Shtackelberg in Shtackelberg's (1956) key to the palearctic species of *sphegina,* and thus *hansoni:* appears to be of palearctic origin. It can be separated from the latter species on the basis of its unique structures on the postabdomen, fourth sternite armature and pollinose front. The nomenclature used in describing the postabdomen is that of Metcalf (1921).

I take great pleasure in naming this unique syrphid after a rather unique person, Dr. John F. Hanson, who not only has been of invaluable aid to me in my studies but also has been a constant source of intellectual enlightenment.

I would like to thank Drs. R. L. Coe and J. R. Vockeroth for their valuable comments on this insect.

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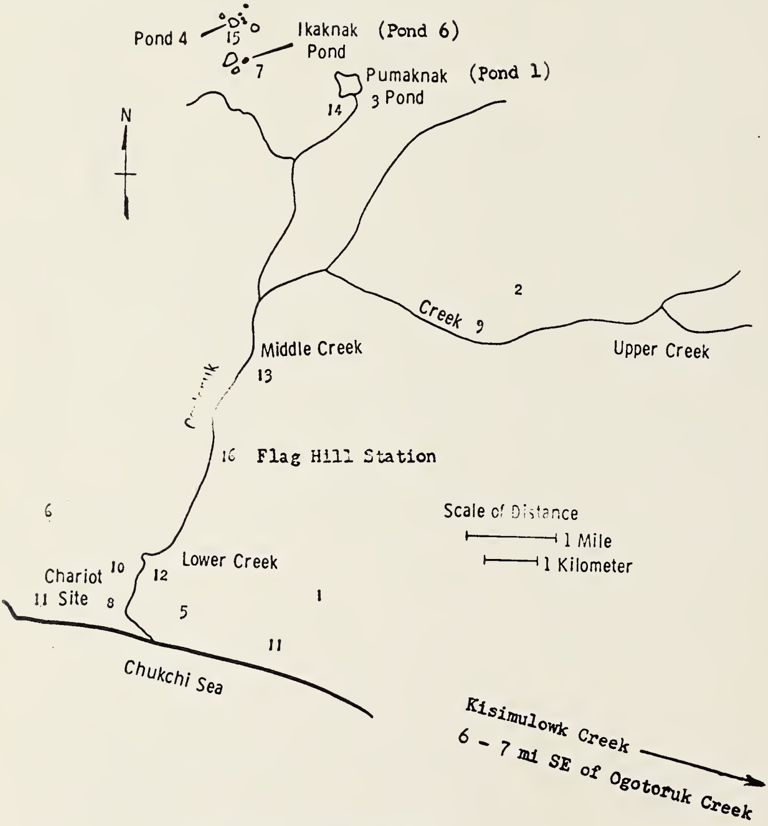
Shtackelberg, A. A. 1956. Neue Angaben über die Systematik der palaärktischen *Sphegina* Arten. Ent. Obozr. 35: 706–715, 934–943.

ARCTIC MUSCIDAE FROM THE CAPE THOMPSON REGION OF ALASKA (DIPTERA)

By H. C. Huckett, Riverhead, N. Y.

A noteworthy collection of flies belonging to the families Anthomyiidae and Muscidae has recently been received, composed of specimens taken in the region of Cape Thompson, Alaska, near 68° latitude. The material represents a part of the Project Chariot Bioenvironmental Study in association with the general Plowshare Program of the United States Atomic Energy Commission, and was furnished for study by the staff at the Biology Laboratory of the General Electric Company at Richland, Washington. A map of the collecting sites of the Ogotoruk area was provided and is


Pond 4
15
Ikaknak (Pond 6)
Pond
7
Pumaknak (Pond 1)
3 Pond
14
N
2
Creek 9
Upper Creek
Middle Creek
13
16 Flag Hill Station
6
Scale of Distance
1 Mile
1 Kilometer
Chariot 10
11 Site 8
12
Lower Creek
5
1
11
Chukchi Sea
Kisimulowk Creek
6 – 7 mi SE of Ogotoruk Creek

Ogotoruk Collecting Sites

here reproduced.

The collections were made during the months of June, July and August, 1959 to 1962, in part by J. J. Davis, W. C. Hanson, R. R. Adee, H. E. Erdman, D. E. Douglass, D. G. Watson, W. O. Pruitt and E. Paddock.

I have been able to recognize 81 species, of which 14 are regarded as new to science. Of the latter, one is herewith described and 13 are included in a forthcoming treatise on the arctic and subarctic Muscidae of North America.

Fucellia biseriata, n. sp.

Male.—Resembling *F. pictipennis* Becker, from which the male of *biseriata* may be distinguished by the series of short coarse bristles on both antero- and posteroventral surfaces of hind femur. Head with frons wider than distance between first pair of dorsocentral bristles, interfrontalia dull red, with one pair of cruciate bristles, parafrontals, parafacials and cheeks browned, face and occiput gray, second antennal segment grayish, third blackish, third aristal segment slightly thickened on proximal half, palpi pale gray, margins pallid, dilated on distal half, haustellum polished. Mesonotum with 2 brownish stripes each along planes of dorsocentral bristles, scutellum brownish at base of basal bristles, meso- and metapleural spiracles with pale peritremes and enlarged, prealar bristle present, sternopleural bristles arranged 2 or 3: 2. Abdomen gray, with a faint darker stripe, processes of sternum 5 with a few slender bristles on distal half of inner margin and of outer border.

Fore tibia with a fine mid anterodorsal and setulose posteroventral bristle, mid femur with proximal series of slender anteroventral and extensive series of firm erect posteroventral bristles that are scarcely longer than maximum height of femur, and becoming weaker on distal third, mid tibia with 1 anterodorsal and posterodorsal bristle respectively, and a weak setulose ventral bristle evident in type under higher powers, hind femur with extensive series of 12 to 14 short anteroventral and a similar series of shorter coarse posteroventral bristles extending to basal region of femur, the latter having 2 or 3 slender posteroventral bristles fully as long or longer than height of femur where situated, hind tibia with 3 anterodorsal, 2 posterodorsal and a weak setulose anteroventral bristle, preapical mid dorsal set at a level basad of preapical anterodorsal bristle.

Wings grayish and unmarked, cross veins faintly darkened, costal setulae coarse, knobs of halteres purplish. Length, 4.5 mm.

Holotype.—♂, Junction of Noatak and Kelly Rivers, Cape

Thompson, Alaska, 12 Aug. 1962. (Douglass) U.S.N.M.

Additional records:

Fucellia antennata Stein. Lower Ogotoruk Creek[1], 2 ♂, 5♀. Kisimulowk Creek, 2 ♂, 1♀.

Fucellia pictipennis Becker. O. C., Pond 1, 1 ♂, 1 ♀; Pond 6, 1 ♀.

Pseudochirosia albipennis Ringdahl. O. C., Pond Area, 3 ♂, 3 ♀.

Hylemya variata (Fallén). O. C. Valley, 1 ♂, 1 ♀. Flag Hill, 2 ♀. Chariot Site, 1 ♂.

Delia echinata (Séguy). UA Botany Plot 9, 2 ♂, 2 ♀. ¾ mi from sea shore, 1 ♀.

Delia liturata (Meigen). O. C., Pond Area, 1 ♂.

Delia pratensis (Meigen). O. C. and shore, 1 ♂, 1 ♀.

Delia rondanii (Ringdahl). O. C., Pond Area, 1 ♂, 1 ♀. Flag Hill, 1 ♂.

Lasiomma morionella (Zetterstedt). O. C. Valley, 1 ♀; Pond Area, 1 ♀; Pond 1, 2 ♂. Flag Hill, 1 ♀.

Lasiomma octoguttata moesta (Holmgren). Flag Hill, 1 ♀.

Pegohylemyia betarum (Lintner). Flag Hill, 1 ♂, 2 ♀.

Pegohylemyia hucketti Ringdahl. Flag Hill, 1 ♂.

Pegohylemyia incursa (Malloch). O. C. Valley, 1 ♀; Pond 4, 1 ♀. Ponds at source of O. C., 1 ♂, 1 ♀. Kisimulowk Creek, 1 ♂.

Pegohylemyia profuga (Stein). O. C. Valley, 1 ♀. O. C. and shore, 1 ♀. Ponds at source of O. C., 1 ♀.

Pegohylemyia sericea (Malloch). Kisimulowk Creek, 1 ♀.

Egle atomaria (Zetterstedt). Crowbill Mountain, 1 ♂.

Egle pilitibia Ringdahl. UA Botany Plot 9, 1 ♀.

Paregle radicum (Linnaeus). Flag Hill, 1 ♀. Junction of Noatak-Kelly Rivers, 1 ♀.

Craspedochaeta pullula (Zetterstedt). O. C., Pond Area, 1 ♀.

Eremomyia turbida Huckett. UA Botany Plot 9, 1 ♂.

Pegomya corrupta Huckett. O. C., Snowpatch, 7 ♂; Pond 4, 2 ♂, 4 ♀. Upper Creek Station, 1 ♀. Flag Hill, 1 ♂, 12 ♀. Chariot Site, 1 ♂, 1 ♀.

Pegomya icterica (Holmgren). O. C. Valley, 1 ♀.

Pegomya indicta Huckett. O. C., Pond 1, 1 ♀.

Pegomya pilosa Stein. O. C., Snowpatch, 1 ♂. Flag Hill, 2 ♂, 1 ♀. Crowbill Mountain, 1 ♂.

Pegomya tenera obscurior Collin. O.C., Snowpatch, 2 ♀. Flag Hill, 1 ♀.

Pegomya tunicata (Zetterstedt). O. C., Pond 4, 1 ♂.

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[1] Ogotoruk Creek is hereafter abbreviated to O. C.

Nupedia pseudodissecta (Ringdahl). O. C. and dunes, 1 ♂; Pond 1, 1 ♂; Pond 4, 1 ♂, 3 ♀. Flag Hill, 3 ♂, 3 ♀. UA Botany Plot 4, 2 ♀. ¾ mi from sea shore, 1 ♀. Kisimulowk Creek, 1 ♂.

Pseudonupedia intersecta arctica (Ringdahl). O. C., Pond 4, 1 ♀. UA Botany Plot 4, 1 ♀.

Paraprosalpia incisa (Ringdahl). O. C. Pond 6, 1 ♂.

Paraprosalpia moerens (Zetterstedt). O. C., Pond 1, 1 ♂, 2 ♀; Pond 6, 1 ♀. Upper Creek Station, 1 ♂.

Hydrophoria alaskensis Malloch. O. C., Pond 1, 1 ♂; Pond 6, 1 ♂. Upper Creek Station, 1 ♂, 1 ♀. UA Botany Plot 9, 1 ♂, 3 ♀. Crowbill Mountain, 4 ♂, 3 ♀.

Hydrophoria brunneifrons (Zetterstedt). ¾ mi from sea shore, 1 ♂.

Hydrophoria frontata (Zetterstedt). O. C., Pond 6, 1 ♀. Upper Creek Station, 1 ♀.

Hydrophoria polita Malloch. O. C. Valley, 1 ♂; Pond 6, 1 ♀.

Hydrophoria seticauda Malloch. Flag Hill, 1 ♀.

Hydrophoria teate (Walker). O. C., Pond at source, 1 ♂, 1 ♀; Pond 1, 2 ♀; Pond 4, 4 ♀; Pond 6, 3 ♀. Flag Hill, 1 ♂.

Hydrophoria tristis (Ringdahl). O. C., Pond 6, 1 ♂.

Limosia atritibia (Ringdahl). O. C. Valley, 1 ♀. UA Botany Plot 9, 1 ♀.

Hoplogaster octopunctata (Zetterstedt). UA Botany Plot 9, 1 ♀.

Lispocephala erythrocera (Robineau-Desvoidy). O. C., Pond 4, 1 ♀.

Spilogona arctica (Zetterstedt). O. C., Pond 4, 1 ♂; Pond 6, 1 ♀. Flag Hill, 10 ♂, 6 ♀. Chariot Site, 1 ♂. Kisimulowk Creek, 1 ♂.

Spilogona arenosa (Ringdahl). Flag Hill, 1 ♀.

Spilogona baltica (Ringdahl). Flag Hill, 1 ♂.

Spilogona fimbriata (Schnabl). O. C., Pond 6, 1 ♂.

Spilogona imitatrix (Malloch). O. C., Pond 4, 1 ♂. Flag Hill, 1 ♂.

Spilogona latilamina Collin, Flag Hill, 1 ♀.

Spilogona malaisei (Ringdahl). O. C., Pond 4, 1 ♀. Flag Hill, 1 ♀.

Spilogona micans (Ringdahl). Flag Hill, 1 ♂.

Spilogona norvegica Ringdahl. O. C., Snowpatch, 1 ♀; Pond 4, 4 ♀. Upper Ogotoruk Creek, 1 ♀. Flag Hill, 2 ♀.

Spilogona obsoleta (Malloch). O. C., Ponds at source, 1 ♂.

Spilogona opaca Schnabl. Flag Hill, 2 ♂, 2 ♀.

Spilogona pseudodispar (Frey). O. C., Pond Area, 1 ♀.

Spilogona pusilla Huckett. Flag Hill, 1 ♀.
Spilogona sospita Huckett. O. C. Valley. 1 ♂, 1 ♀. O. C. and shore, 1 ♀; Ponds at source, 1 ♀. Kisimulowk Creek, 1 ♂.
Spilogona triangulifera (Zetterstedt). O. C., Pond 6, 4 ♂, 7 ♀. Upper Creek Station, 1 ♂. Kisimulowk Creek, 1 ♀.
Helina bohemani Ringdahl. O. C., Pond at source, 1 ♀.
Helina luteisquama Ringdahl. O. C., Pond Area, 1 ♀. Flag Hill, 1 ♂.
Mydaea palpalis Stein. O. C., Pond 1, 1 ♀. Upper Creek Station, 2 ♂, 1 ♀. Flag Hill, 1 ♂. UA Botany Plot 4, 2 ♂. Kisimulowk Creek, 1 ♂.
Fannia aethiops Malloch. Middle O. C., 1 ♂.
Fannia manicata (Meigen). Junction of Noatak-Kelly Rivers, 2 ♀.
Fannia spathiophora Malloch. UA Botany Plot 4, 1 ♀.
Fannia tundrarum Chillcott. O. C., Pond 4, 1 ♂.
Hydrotaea bispinosa (Zetterstedt). ¾ mi from sea shore, 1 ♂. Flag Hill, 1 ♂, 1 ♀.
Hydrotaea cristata Malloch. Junction of Noatak-Kelly Rivers, 1 ♀.
Lasiops subrostratus (Zetterstedt). UA Botany Plot 9, 1 ♂.
Phaonia rugia (Walker). Flag Hill, 1 ♂.
Lophosceles frenatus (Holmgren). O. C. Valley, 1 ♂. Upper O. C., 1 ♂. UA Botany Plot 4, 1 ♂, 1 ♀. Kisimulowk Creek, 1 ♂, 1 ♀.

BOOK REVIEW

Lepidoptera of Florida by Charles P. Kimball, with an Index of Plant Foods, an annotated Bibliography, Map and Gazetteer of Florida, 363 pp., 6 plates in color, 20 plates in black and white, published by the Division of Plant Industry, Florida Department of Agriculture, 1965, (Price, $5.00)

In a foreword, the Editor, Howard V. Weems, Jr., states that this is the first of a series of publications, relating to insects and other arthropods of Florida, the Bahamas and West Indies with emphasis on taxonomy, biology, ecology and zoogeography. If subsequent volumes measure up to this one in scope and treatment and are as handsomely mounted, the series will be a notable contribution to the literature.

Almost a half century has elapsed since John A. Grossbeck's List of Florida Lepidoptera was published by the American Museum of Natural History, under the editorship of Frank E. Watson, after Grossbeck's untimely death in Barbados in 1914. This was the first comprehensive survey of the Lepidoptera of Florida and it is surprising that it covered 147 pages in view of the limited collecting done up to that time.

Kimball's list represents 12 years of work on his part with the cooperation of numerous others whose assistance is meticulously recorded. In a 27 page thought provoking introduction, he raises about as many questions as he answers. A number of these center around the geographical location of Florida, the proximity of the islands of the Caribbean and the influence of a subtropical climate. As an example, the occurrence of exotics on the mainland through migration or plant introduction has created a confused situation which is not clearly understood even now and invites extended study.

In preparing the new list, Kimball has drawn on Grossbeck as the primary source. However, as many of Grossbeck's records were undocumented, he has tried to trace them back to their sources. The search has produced a long and interesting list of collectors, professional and amateur, who have done field work in Florida over the years.

Although William Bartram made a recognizable observation of *H. charitonius* on the east coast in 1774, the first important collector was Edward Doubleday in 1837. Regular collecting began with Roland Thaxter in 1875, followed by A. Koebele, W. Beutenmiller and H. G. Dyar. Mrs. A. T. Slosson was in the field about the turn of the century and ten years later the American Museum of Natural History group, consisting of J. A. Grossbeck, W. T. Davis, J. Mattes and J. H. McDonnough. As interest in Florida grew, the number of collectors increased, and substantial contributions were made by many others. Among them were Frank Morton Jones, Mrs. Leslie Forsyth, Otto Buchholz, A. K. Wyatt, C. P. Kimball, Mrs. Shirley Hills and S. V. Fuller, in addition to the growing ranks of professionals in university and government service Despite the number and the eminence of some of the names, the areas covered were spotty and the duration of field work rarely sustained until recent times. A gazetteer which follows the list shows blanks in many areas.

This situation is highly regrettable. It so happens that Florida, like California, is an area particularly favorable to Lepidoptera. Both states are in a period of rapid development and exploitation which is, however, narrowing opportunities for field collecting. Only a few years ago, one of the two places in Florida, where, after years of searching, I found a series of a new heliothid moth, was real estate when I checked it two years later.

It is not practical to expect professional entomologists, relatively few in numbers and burdened with other problems, to solve this one. However, field collecting can be done well by amateurs. Here is an area is which college zoology departments and entomological societies could do a constructive job. By stimulating an interest on the part of amateurs in filling in the record, much could be salvaged before the opportunity is gone. Many worth while projects languish for lack of funds. All this one needs is imagination and a little initiative.

Even a casual inspection of the list reveals the many gaps in our knowledge of what is already recorded. Numerous specimens are listed by genus only, and are yet to be described. Time and again Kimball lists a specimen as doubtful and then reviews the confused record of distribution or, more often, the confused taxonomic situation involved. At a time when many entomologists are taking off in new and expanding fields of research, we are left with a lot of homework to be tidied up by someone.

Kimball has attained a high level of completeness. The reference to the original description is supplied, as well as detailed records of time and place of capture, and the collector, with relevant comments on authenticity of records and determination. To this end he has enlisted the cooperation of numerous collectors, curators and specialists. While many records have been supplied from it, the chief untapped source is the great collection of the United States National Museum which presumably will not be eroded by our expanding economy and will remain available against the day when a specimen by specimen check can be made at least in representative groups. Plans have been made by the Division of Plant Industry to continue to accumulate data for publication in supplement form at appropriate times.

Many of the Lepidoptera of Florida, of course, are to be found in neighboring Gulf and south Atlantic states which enhances the usefulness of Kimball's work. It is fortunate that what has been discovered in Florida in the past half century is here so well recorded. The publication is handsomely mounted. Because of its bulk, the additional cost of a cloth binding would have contributed greatly to its durability. The type is large and easily read. Despite the fact that the text consists largely of proper names, it is singularly free from typographical errors.

Six color plates depict some two hundred and fifty specimens and 20 plates in black and white about seven hundred additional. An index of food plants contains about sixteen hundred references, which in many cases include both the scientific and common name of individual plants.

Rowland R. McElvare

THE BIOLOGY OF *MASTRUS ARGEAE* (VIERECK) (HYMENOPTERA: ICHNEUMONIDAE), A PARASITE OF PINE SAWFLY PREPUPAE.

By Marvin L. Bobb[1]

An extension outbreak of the Virginia-pine sawfly, *Neodiprion pratti pratti* (Dyar), began in Virginia in 1957. Two years later more than two mlilion acres of pine forest, comprising all or parts of forty counties, had some degree of defoliation (Bobb, 1963; Morris *et al.,* 1963). Studies were begun in 1959 on the biotic factors influencing the population densities of the Virginia-spine sawfly. In connection with these studies, the biology of several of the more important parasites was studied in detail.

Mastrus argeae (Viereck) was described from a female reared from the cocoon of a species of *Hylotoma* on elm in Ohio (Viereck, 1911). The species on which the biology is given in this article is considered by the author to be *M. argeae.* However, numerous specimens have been identified by specialists at the U. S. National Museum as *Mastrus* sp.; probably due to the limited original description, and to the variations among individual specimens.

METHODS

Unmated *Mastrus* females, or pairs of individuals, were confined in 4-ounce oviposition jars which had moist sand in the bottom on which a number of pine sawfly cocoons were placed. Sugar water on a cotton plug was added as food for the adults. After the adults were released into the oviposition jars, the tops were covered with three thicknesses of cheese cloth. The oviposition jars were then placed in a cabinet, approximately 3′ × 3′ × 4′ in size, in which the temperature and humidity were controlled. The sides, top and bottom of the cabinet were constructed of 3 walls of hardboard with two air spaces between, and the door was similarly constructed with a window of glass through which a themometer and a SERDEX hydrometer could be observed. An electric fan constantly circulated the air within the cabinet. The temperature was thermostatically controlled and a satuated solution of sodium acetate was used to control the relatively humidity. A temperature of 75 ± 2 degrees F., and a relative humidity of approximately 75 percent were maintained.

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[1] Entomologist, Virginia Agricultural Experiment Station, Piedmont Fruit Research Laboratory, Charlottesville, Virginia.

The sawfly cocoons were removed from the oviposition jars several times daily and new cocoons added. Each cocoon was cut open and the sawfly prepupa and *Mastrus* egg transferred to a number 5 gelatin capsule. Thse were placed in numbered racks in the cabinet with controlled temperature and humidity.

Observations were made at frequent intervals during the day to ascertain time of egg hatching, larval molts, pupation and adult emergence. Measurements were made on the width of the head capsule of the larvae, and on the length and width of each of the several life stages. At each molt the cast exuvium was removed from the capsule. All measurements were made with the aid of a micrometer disc in the eyepiece of a binocular microscope at a magnification of 80 times.

LIFE HISTORY

The adults of *Mastrus argeae* began emerging in late April when the Virginia-pine sawfly was in the larval stage. The females oviposited within the cocoons of the sawfly prepupae, and the parasite larvae fed externally upon the host. Under field conditions the parasite had three or more generations each year on Virginia-pine sawfly prepupae, with straggling individuals emerging through September. The majority of the individuals maturing after midsummer did not emerge as adults until the following spring (Plate I.) The parasites overwintered as full-grown larvae in small, white, silken cocoons within the host cocoon.

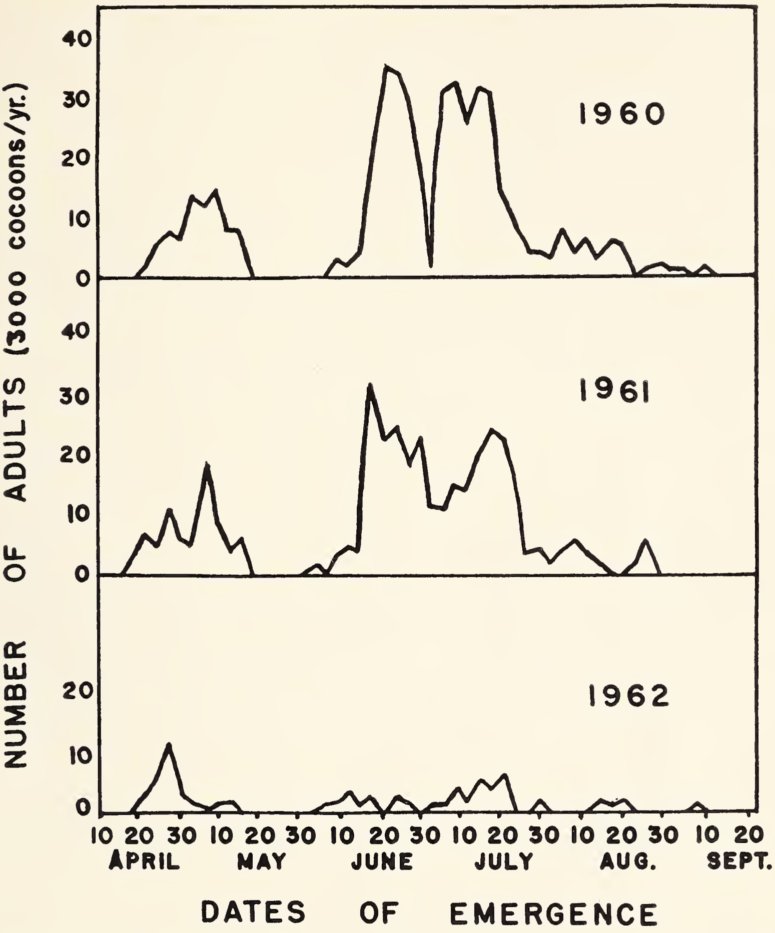
Descriptions of the stages and life history data are presented below and in Table 1. A total of 226 individuals was reared from egg to adult in gelatin capsules under controlled conditions of temperature and humidity. At 75° F., the total life cycle from egg to adult emergence varied from 16.5 to 21.0 days and averaged 18.4 days.

The Egg—The newly deposited egg was oblong, pointed toward each end, and nearly transparent; but after a few hours, it changed to an opaque-white color. After approximately 12 hours, the embryo was seen developing as a long, yellow area in the center portion of the egg, and the egg contents began to recede from each end of the chorion. The anterior fourth of the egg enlarged as the embryo neared maturity (Plate II, Figures 3 and 4).

The Larva.—There were five larval instars. Starvation was not a factor in larval development since only one parasite developed on each sawfly prepupa and there was therefore an abundance of food. Only slight variations occurred in the width of the head capsule within a particular stadium. The total larval period, in-

Plate I

Bobb



Time of emergence of *Mastrus argeae* (Viereck) from cocoons of the Virginia-pine sawfly at Charlottesville, Virginia, from 1960–1962.

cluding the time spent in constructing a cocoon averaged 7.7 days at 75° F.

When the embryo was fully formed it slit the anterior end of the chorion, and the young larva wiggled out. When first hatched the larva had a relatively large head, slightly wider than long, and thirteen distinct body segments which tapered posteriorly (Plate II, Figure 5). The body was whitish, vaguely transparent, with the intestinal tract slightly visible. The head was shiny with a yellowish-brown tinge of color, and there were two prominant setae or tubercles on the vertex; there were 0.03 mm. in length. The first instar larvae varied in size from 0.88 mm. long and 0.23 mm. wide just after hatching to 1.34 mm. in length and 0.35 mm in width before the molt

The secand and third instar larvae closely resembled the first except for size (Table 1). The body was opaque-white in color.

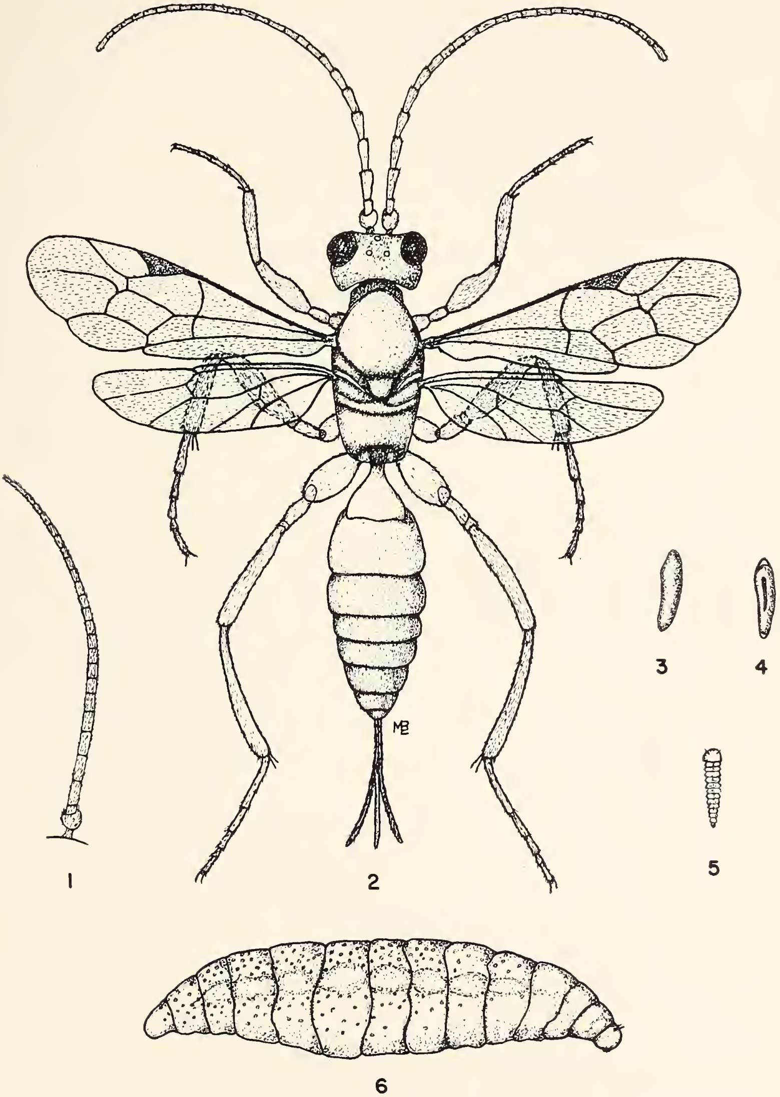
The fourth instar larvae were brownish in color due to the accumulation of food and waste materials within the body. The head was much smaller in relation to the body. The segments of the body were less distinct and ridges and folds of integument began to form laterally along the body. White globules began forming under the integument on the posterior half of the abdomen near the end of the fourth instar feeding period.

The body color darkened and the larvae became a brownish-black during the fifth instar. The body segments were not so distinct as during the other stadia, and the folds and ridges along the sides of the body became larger (Plate II, Figure 6). The white globules increased in numbers under the integument of the abdomen.

The Cocooning Larva.—After completing feeding, the larvae spent an average of 2.1 days in constructing a cocoon. The cocoon was spun from the mouth of the larva and consisted of white silken threads. It was constructed in one end and side of the host cocoon, and just large enough to accommodate the larva. The host cocoon was used as one side of the parasite cocoon and silken threads were spun sparingly over this area. The pupa or larva could be readily observed through the silken threads spun over the side of the cocoon attached to the capsule.

The Prepupa.—Soon after the cocoon was completed the larva discharged all of the brownish body contents and transformed into the prepupal stage. In this stage the body consisted of three distinct regions; the head, the thorax and the abdomen. The head and thorax were uniform in width and much narrower than

PLATE II BOBB



All figures are of *Mastrus argeae* (Viereck) and all are drawn to the same scale. Fig. 1, Antenna of male. Fig. 2, Adult female. Fig. 3, Newly deposited egg. Fig 4, Egg after twelve hours. Fig. 5, First instar larva soon after hatching. Fig. 6, Mature fifth instar larva.

the abdomen, which was expanded laterally near its center and tapered posteriorly. When first formed the prepupa was uniformly white in color but yellowish-brown eye spots and the ocelli became visible after a few hours. The prepupae averaged 6.23 mm. in length and the lengths of the tagmata were as follows: head 0.91 mm., thorax, 1.35 mm. and abdomen 3.97 mm. The prepupal period varied from 1.5 to 2.0 days in length.

The Pupa.—The newly formed pupa was uniformly white in color, but the eyes and ocelli were slightly visible as yellowish-brown spots. After two days the color of the pupa was a yellowish-white and the eyes and ocelli were brownish-red. Coloration of various parts of the pupa changed rapidly during the next several days. First the head, thorax and basal portions of the abdominal segments gradually changed to gray and then to black. The antennae, wing pads and venter of the abdomen remained white except for a lateral row of black spots on each side of the venter. The legs changed to a reddish-brown except for the tarsi which were yellowish-white. The day before the pupa changed into the adult stage the antennae and wing pads darkened, and the head, thorax and dorsum of the abdomen of the male changed to black. The coloration of the female pupa was the same except that the dorsum of the abdomen changed to red. The ovipositor of the female was curved up over the dorsum of the abdomen throughout pupal

Table 1. Biological data on the life stages of *Mastrus argeae* (Viereck) at a constant temperature of 75 ± 2 degrees F. and a relative humidity of approximately 75 percent.

Life Stage	Avg. Length (mm.)	Avg. Width (mm.)	Avg. Width of Head Capsule (mm.)	Avg. Duration of Stage (days)
Egg	1.06	0.23	—	2.0
First instar larva	1.07	0.29	0.22	1.2
Second " "	1.71	0.50	0.30	1.0
Third " "	2.70	0.87	0.40	1.0
Fourth " "	4.00	1.30	0.51	1.0
Fifth " "	5.80	2.08	0.68	1.4
Cocooning larva	5.92	2.06	0.68	2.1
Prepupa	6.23	2.02	—	1.7
Pupa	5.85	—	—	5.8
Adult in cocoon	—	—	—	1.2
Total				18.4

life. The size of the pupae varied from 5.38 mm. to 6.57 mm.

The Adult.—After assuming the adult form, the parasite remained in its cocoon for an average of 1.2 days. The female normally remained in the cocoon from 0.5 to 1.0 day longer than the males. During this time the eggs matured in the ovaries of the female and she was ready to mate upon emergence from the cocoon.

Viereck described *Mastrus argeae* from apparently a single female and no description of the male was given. Considerable variations in diagnostic characters are exhibited by individual specimens reared from the Virginia-pine sawfly. Thus descriptions of the female and the male follow.

Female.—Body length 5.5 mm. to 6.7 mm. Head capsule black with short whitish pubescence; face dullish, minutely punctured; clypeus reddish-brown. Mandibles mostly castaneous with apical edge black. Maxillary palpi stramineous, 5-segmented: 16 : 19 : 27 : 16 : 24. Antennae castaneous throughout, set in depressed area between eyes, scape bulbous, pedicel small. Flagellum with 23 to 26 segments, the six basal segments very distinct, each with apex much wider than base. First basal segment a little shorter than second but thereafter each a little shorter than the one preceeding. Segments beyond middle less distinctly delimited and more nearly equal in length, except apical segment which is nearly twice as long as the preceding two together. Thorax black, shining, with minute punctures and inconspicuous whitish pubescence. Propodeum black, shining, flat shallow groove for reception of first abdominal segment surrounded by carina, groove nearly twice as wide at apex as at base. Wings transparent tinged with brown, clothed with small erect hairs, base yellow, veins and stigma brown. Legs mostly castaneous. Dorsum of abdomen translucent reddish-brown, smooth, shining, first segment (petiole) edged with black laterally, venter testaceous. Ovipositor castaneous, sheath dark brown, shorter than abdomen. (Plate II, Fig. 2).

Male.—Body length 5.1 mm. to 6.5 mm. Head mostly as in female except mandibles with basal ⅔ stramineous, apical ⅓ castaneous to black. Antennae filiform, dark brown, scape bulbous and stramineous below and brownish-black on basal portion above. Flagellum with 21 to 24 indistinct segments, each segment a little shorter than the preceding except beyond the middle they are more nearly equal, and ultimate segment twice the length of penultimate (Plate II, Fig. 1). Thorax and wings as in female. Legs mostly reddish-yellow, tarsi dark brown and apical portion of hind tibia shading into dark brown, basal portion of hind coxa brownish-black. Dorsum of abdomen mostly black, caudal edge of segment 2 red, 3 mostly red, 4 partly red. Venter stramineous with row of brownish-black spots along lateral edges of segments 2 through 5, caudal segments black.

The adults have fully developed wings and are very rapid in flight. However, they generally remained in the duff on the forest floor and crawled around in search of sawfly cocoons. They were negatively phototropic, preferring the darkness. The wings lay flat over the dorsum of the abdomen when at rest, and the insects were able to crawl through very small spaces.

At a temperature of 75° F. and a relative humidity of approximately 75 percent, the average length of adult life of 25 females was 5.0 days and that of 25 males was 3.4 days.

Mating and Oviposition.—The male and female mated soon after emergence from the cocoons. Copulation required from 15 to 26 seconds, and the females were never observed to mate more than once. Very few eggs were matured by an individual. The numbers deposited ranged from 2 to 19 and averaged 7.2 per female for 50 individuals. The numbers of eggs in the ovaries of females which were dissected generally varied from 6 to 9 with no others in the process of development. Usually when more than 10 to 12 eggs were deposited, the last few did not hatch.

When ready to oviposit, the female parasite thrust her ovipositor through the cocoon of the pine sawfly prepupa and paralyzed it. This was important since the egg and first-instar larva were very easily crushed by any movement of the sawfly prepupa. After the prepupa within the cocoon had been paralyzed, the female parasite again inserted her ovipositor through the host cocoon and deposited an egg loosely in the cocoon or on the sawfly prepupa. She oviposited only one egg, but sometimes returned one or more times to deposit additional eggs within the same cocoon. As many as five eggs have been found in one cocoon. The eggs from unmated females produced only male specimens.

The young larvae of *Mastrus argeae* are cannibalistic, and the first larva to hatch from an egg seeks out all other eggs or larvae within the cocoon and kills them by sucking out the fluids. It then began feeding on the underside of the sawfly prepupa. Except for brief periods when changing from one instar to the next, the larvae fed continuously from hatching to maturity.

Discussion

During 1960 and 1961, *Mastrus argeae* was the second most abundant parasite of the Virginia-pine sawfly. It occurred in 22 sawfly-infested counties of Virginia, and parasitized approximately 14 percent of the sawfly prepupae. With the decline of the sawfly population during 1962, however, *Mastrus* individuals became less numerous (Plate I), although the percentage of parasitism remained relatively high in a few counties. The sawfly population further declined during 1963 and only an occasional *Mastrus* parasite was reared from collections of cocooned prepupae.

The life cycle of *M. argeae* was not synchronized with the development of the Virginia-pine sawfly. The overwintering larvae transformed into the pupal stage and emerged as adults during the feeding period of the sawfly larvae. There were very few unparasitized sawfly prepupae in cocoons in the duff at this time for *Mastrus* to parasitize, although frequently there were considerable numbers of *Exenterus, Endasys* and *Villa* parasite larvae present in sawfly cocoons. Observations do not support the theory, however, that *Mastrus argeae* was hyperparasitic. It seems more probable that *Mastrus* had another host at this time of year. Adult emergence strongly indicated that a generation was produced on an alternate host before Virginia-pine sawfly prepupae in cocoons were available.

SUMMARY

A description of the life stages of *Mastrus argeae* (Viereck), and the results of studies on the life history and habits of the parasite are presented in the text and summarized here.

The eggs were deposited within the host cocoon and hatched in 2 days at 75° F.

There were five larval instars and the average duration of each stadium at a constant temperature of 75° F. was: first, 1.2 days; second, 1 day; third, 1 day; fourth, 1 day; fifth, 1.4 days. The mature larvae spent 2.1 days in constructing a cocoon. The prepupal period lasted 1.7 days and the pupal period 5.8 days. The total life cycle from egg to adult emergence averaged 18.4 days.

Very few eggs were produced by the adults, the average being 7.2 per female. The progeny from unmated females were all males.

At a temperature of 75° F. and a relative humidity of approximately 75 percent, the average length of adult life was 5.0 days for the females and 3.4 days for the males.

The life cycle of *Mastrus argeae* was not synchronized with the development of the Virginia-pine sawfly, and observations indicate that there may be another host.

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OBSERVATIONS ON CASE-BUILDING BY *NEMOTAULIUS HOSTILIS* (HAGEN) LARVAE (TRICHOPTERA: LIMNEPHILIDAE)[1]

By Sarah A. Bernhardt

While numerous observations on case-building by Trichoptera exist in the literature (e.g., Dembowski, 1933, Fankhauser and Reik, 1935, Gorter, 1931, and Hanna, 1957, 1960), the case-building behavior of very few North American species has been intensively studied. Portable larval cases are constructed by members of 12 of the 17 families represented in North America. The present study deals with the case-building of one species, inhabiting lentic waters, under natural and experimental conditions.

Description of natural case.

Cases collected in the present study were composed of threadlike blades of *Eleocharis,* small twigs, twig and leaf material, *Eleocharis* and leaf, or entirely of leaf pieces. The leaf pieces identified included leather leaf (*Chamaedaphne*) and a variety of leaves from deciduous trees. Cases of young larvae in the University of Massachusetts collection and of early instars collected during September and October of 1960 were composed primarily of small twigs, *Eleocharis,* or a combination of the two. These cases were roughly cylindrical and constructed of various lengths of material placed obliquely with respect to the long axis of the case. Larger twig cases contained a majority of pieces placed longitudinally but still of irregular size and shape. Nearly all mature larvae occupied leaf cases. Occasionally the cases were in process of transition from *Eleocharis* or twig to leaf composition as also observed by Flint (1960). The degree of correlation between larval size (age) and case material used is illustrated in Table 1 below.

A change in the pattern of the case accompanying the change from grass or twig to leaf material is illustrated in Figure 1. Flint (1960) described a change in case pattern by mature larvae of *Nemotaulius hostilis* from a transverse to longitudinal arrangement of pieces. Only two cases of mature larvae collected by the author exhibited this longitudinal arrangement and these two cases were of twig rather than leaf material. The cases of all other terminal instar larvae and pupae collected by the author in the vicinity of Amherst, Massachusetts, (September 1960–May 1961) and near Newcomb, New York, in the central Adirondacks in October 1961 consisted externally of nearly semi-circluar leaf pieces placed crosswise along the axis of the case. These cases appear to be identical to the case illustrated by Hicken (1946) for larvae of *Glyphotaelius pellucidus.* Case illustrations for *Nemotaulius hostilis* given by Lloyd (1921) and Pennak (1953) are similar to the pattern described by Flint (1960). A longitudinal arrangement of leaf pieces has also been described for the final case of terminal instar larvae belonging to the related species *Nemotaulius punctatolineatus* (Wesenberglund, 1910) and it may be that the difference in external appearance of the terminal instar case is largely due to a difference in the type of leaf material available in the larval habitat.

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[1] This paper is modified from a portion of a thesis submitted to the University of Massachusetts in partial fulfillment of the requirements for the Master of Arts degree.

Table 1. Modification in case material used by *Nemotaulius hostilis* with increase in larval size (Measurements in centimeters).

Case material	Twig, "grass,"* or combination	Leaf with twig or "grass"	All leaf
Number of larvae	20	11	50
Average length of case	1.0	1.4	2.4
Range of case lengths	0.6–1.4	1.2–2.0	1.5–3.3
Average length of larvae	0.9	1.1	2.3
Range of larval lengths	0.4–1.2	0.9–1.4	1.5–3.0
Average labrum width	.040	.060	.076
Range of labrum widths	.018–.054	.050–.084	.054–.091

* Refers to *Eleocharis* or like material.

The leaf cases collected in the present study consisted of an inner cylinder of small leaf bits surrounded dorsally and ventrally by a number of larger leaf pieces as shown by the partial dissection of a sample case shown in Figure 2. The posterior opening of grass and twig cases and occasional leaf cases is equal in diameter to that of the inner cylinder. In most leaf cases, however, a silken membrane closes the posterior end except for a very small circular opening at its center. The posterior openings of cases belonging to preterminal and terminal instar larvae are shown in Figure 3. The posterior membrane was not observed in any cases of preterminal instar larvae and was occasionally absent in cases of small terminal instar larvae, indicating agreement with Flint's (1960) observation that the posterior constriction occurs during the final larvae instar.

Removal from original case.

Young larvae left their cases readily when gently prodded from behind. Older larvae, however, exerted an extremely tenacious grip on the case by means of the hooks on their anal prolegs. Usually many seconds elapsed before these larvae left their cases. Upon removal larvae generally moved over the bottom of finger bowl containers, making no immediate attempt to reenter the case. In several instances larvae crawled over the case giving no apparent sign of recognition. Three mature larvae which failed to build new cases following evacuation from their original ones reentered their own or similar cases when these were presented on a later date. Larvae entering the empty cases of other individuals of the same species usually modified the case by a combination of removal and addition of parts.

Building with normal materials.

Upon presentation with the usual natural case-building material following removal from case, no larvae were observed to start construction immediately. The shortest interval observed was 30 minutes. Following varying periods of exploratory behavior, cutting of offered material was begun. The larva generally lay beneath a leaf, ventral surface up, with the posterior half of its abdomen projecting beyond the edge of the leaf. The first pieces cut were of moderate size (approximately 0.2–0.7 centimeters in diameter) and irregular in shape. Later in construction the pieces were of a much larger size, frequently 1.3–1.5 centimeters across and semi-circular in shape. A comparison of the semi-circular cutting for case-building and cutting by the same larvae for feeding is shown in Figures 4 and 6. Following an initial cut for case-building, additional pieces were usually but not always removed from the same area of the leaf. As the first piece was cut it was attached loosely by silk to the larva's back or side and carried along as additional pieces were cut. Successive pieces were then attached to the previously anchored pieces.

As a cut was made a single mandible could be seen (from the upper surface) moving along the incision. It appeared that the right and left mandibles worked in a manner similar to the operation of two scissor blades. The upper mandible thus cut against a relatively rigid lower mandible. During the cutting of a single large piece, the cutting motions of the mandibles were punctuated by short pauses of variable duration. The number of small cuts between these pauses ranged from one to seven with an average of two. During the pauses between cuts the upper mandible was withdrawn below the leaf surface and the two mandibles worked together in what appeared to be a chewing motion. At this time leaf material was not visibly discarded but it has not been conclusively demonstrated that the material therefore passed into the digestive system. Interspersed between the relatively short periods of cutting and chewing motions were longer pauses up to one minute in duration and periods of trimming when the larva used both mandibles to smooth the rough edges of a cut. The cutting of a single large piece frequently required 5–15 minutes.

Normally pieces were attached to the larva or preliminary case as they were cut. Occasionally larvae lost their grip on a piece or paused after a piece had been placed on the anterior edge of the case. In these instances larvae often failed to resume activity in precisely the same location and the cut pieces were consequently never attached to the case. At other times a piece was attached so loosely that it became detached as the larva moved in search of new material.

The assembling of leaf material into a case was accomplished in

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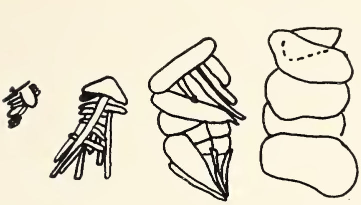
EXPLANATION OF PLATE I

Fig. 1, Transition from grass stem or twig material (left) to leaf material (right) in larval cases of *Nemotaulius hostilis:* accompanying change in length from one centimeter (twig) to two and one half centimeters (leaf). Fig. 2, Partially dissected leaf case of *Nemotaulius hostilis:* A—dorsal view of case, three centimeters in length, with large outer leaf pieces (C) removed from dorsal surface, B—small pieces removed from inner cylinder. Fig. 3, Posterior case openings of *Nemotaulius hostilis.* (Actual total diameter 0.8 centimeters) A—open posterior of T-1 instar care, B—constricted opening of case belonging to terminal instar larva. Fig. 4, Maple leaf with semicircular pieces removed for case-building. Fig. 5, Twig and wood fragment cases of *Nemotaulius hostilis,* ranging in length from one and one half to three centimeters: A—natural case of T-2 instar, B—natural case of T-1 instar, C—experimental case of terminal instar, D—natural case of terminal instar. Fig. 6, Remains of maple leaf after extensive feeding activity. Fig. 7, Experimental water grass cases built by terminal instar larvae: actual lengths, one to one and one half centimeter. Fig. 8, Pine needle case to which leaf material has been added by a terminal instar larva: length, three and one half centimeters.

PLATE I BERNHARDT



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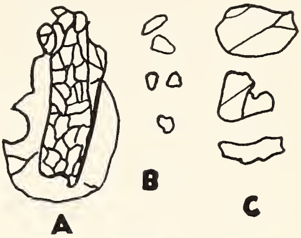

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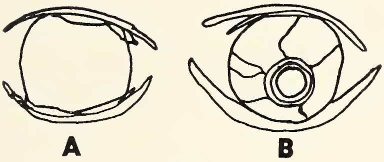

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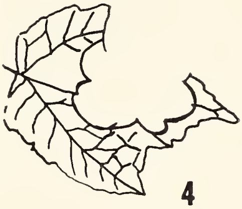

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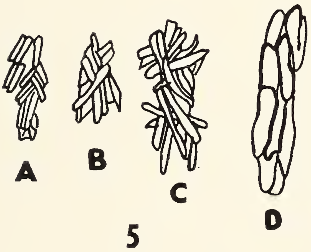

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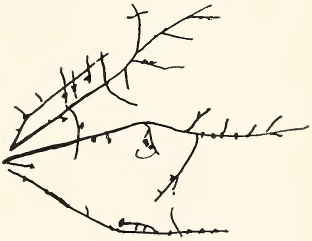

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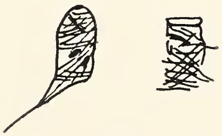

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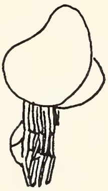

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several different ways. In one series of 16 larvae, 10 first attached leaf piece to their dorsal abdominal surfaces. From one to three pieces were loosely attached in this position. Subsequently pieces were added laterally and ventrally to the anterior piece to form a square around the abdomen. Other larvae manipulated the original dorsal pieces to form a square tube. Occasionally a square was formed immediately. In contrast to the above, the six remaining larvae attached initial pieces to their ventral surfaces and added subsequent pieces laterally and dorsally to form a closed band. The various methods of construction are illustrated in Plate II. The dorsal plate method and initial formation of a square described here have also been reported by Hanna (1960) for *Glyphotaelius pellucidus.*

Once a girdle or band was formed, the larva remained within and built the remainder of the case around itself. The larva and its preliminary case rotated freely as pieces were added to different areas of the structure. Once a wide belt was formed, pieces were added consistently to the anterior end. When large pieces were added, the case no longer rotated easily and the larva then reversed its dorsoventral orientation to attach additional pieces to the dorsal or ventral surface of the case. All six legs were used in removing a large cut piece from the remaining leaf area. As the piece was brought toward the case, the prothoracic legs released their hold and the leaf piece was set in place by the meso- and metathoracic legs. The edges of the leaf were now held in the angle of the femur and tibia while the tarsal claws balanced the outer edges. Silk was deposited on the inner surface of the new piece and adjoining part of case by a sidewise movement of the head. At least two to three minutes intervened between cutting and the firm attachment of a piece.

Under experimental conditions larvae required an average of four to five days to complete the construction of a case with normal materials. During initial stages of construction all larvae cut and added only small pieces. After 10 to 12 hours the first large pieces were cut and added to the dorsal and ventral surfaces of the case. Intermittently through the second day more pieces were added to the case until a total length of 3.5–4.9 centimeters was reached. Toward the end of the second day or during the third day, the

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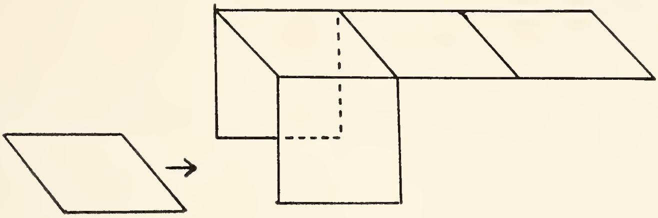
Explanation of Plate II

Fig. 1, Dorsal plate method of case construction in which lateral and then ventral pieces are added to an original dorsal plate. Fig. 2, Dorsal plate method in which original plate is modified to form the square. Fig. 3, Ventral plate method of construction.

PLATE II BERNHARDT



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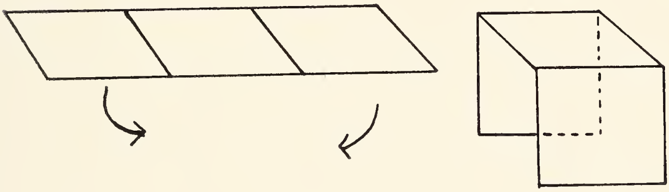

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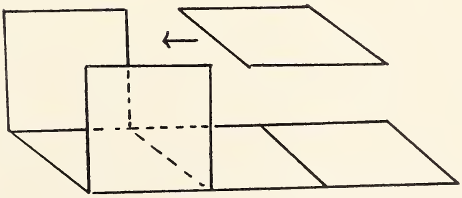

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larva reversed its position in the case and a posterior segment (approximately one centimeter, of the case was detached. Following removal of this loose posterior portion, a silk membrane with a central hole was spun over the posterior opening and the larva returned to its original position. Cases constructed in the laboratory were usually similar to original natural cases but occasionally had a more irregular appearance.

Temperature and light.

In a series of 32 experiments at approximately 50°F. in a constant temperature room, no significant difference in the length of time before onset of construction or in rate of construction was found between larvae under light and larvae under dark conditions. Among larvae under dark conditions the average interval between removal of case and start of construction was 3.3 hours while in the light construction was begun after an average of 3.4 hours. The duration of construction was also similar for larvae in constant dark, alternate light and dark, and constant light. A series of 13 larvae at a room temperature of 75–80°F. and under light conditions, averaged nearly seven hours for the interval prior to construction. The length of time before new construction varied from 30 minutes to 37 hours at the higher temperature and from 45 minutes to 25 hours at 50°. Thus among both groups the range of individual variation was large and in contrast to reports of Lloyd (1921) and McGaha (1952) the larvae did not appear to be more active under conditions of darkness. It may be that the case-building instinct of the larvae is strong enough that it operates in spite of particular light conditions or that light does not normally inhibit or stimulate building activity. Feeding activity may be more directly related to light conditions and account for the variation between present observations and those of the above authors.

The effect of successive experiments on building behavior.

Among seven mature larvae participating in a series of experiments it was found that after four trials the onset of building activity was delayed from an average of three to an average of 24 hours following removal from case. There appears to be no regular increase in the length of duration of construction and in fact this period is somewhat shorter in later experiments occurring just prior to pupation. It seems possible that the delayed response to new normal building material might be due to fatigue or a temporary decrease in the strength of the building instinct. It is not due to the loss of the building instinct as the larvae continued to build new cases in succeeding experiments.

Unusual materials.

With unusual materials, i.e., water grass (*Eleocharis*), twigs, sand, or pine needles, construction was delayed or failed to occur. The difference in rate of response and length of construction period for usual and unusual material is presented in Table 2. The tabulated information includes only the results of first experiments. Observations on additional experiments with unusual materials will be presented in subsequent paragraphs.

Table 2. The effect of unusual materials on the interval before building and the time required to complete a case by terminal instar larvae of *Nemotaulius hostilis* having performed in no previous experiments.

Material	*Usual*	*Unusual*			
	leaf	water grass	twig	pine needles	sand
Total number of larvae used	18	9	5	3	0
Number of larvae building cases with given material	17	8	3	1	
Average time to start (hours)	1½	9½	19	16	
Range in starting time (hours)	½–4	2½–30	12–28	—	
Average duration of construction days	3½	9	2	8	
Range in duration (days)	2–7	4–14	2	—	

It can be seen in Table 2 that the average time between removal of larva from case and initiation of building was much shorter when the larva was presented with leaf material than when any other natural material was given. However, although the longest interval passed before the start of building when twig material was offered, construction with this material was completed in two days, whereas leaf cases required an average of three and one half days for completion. It is possible that this difference in time for completion may be due to the smaller number of pieces required for a single layered twig case as opposed to the double walled leaf case described above. With water grass, twig, and pine needle materials, the length of time before start of construction appears to show a direct relationship to the diameter of the objects presented. The duration of construction for the three materials does not follow this pattern and may be more dependent on the degree of efficiency with which the larvae manipulate the material. It should be noted that with all materials, including the normal leaf pieces, one or more larvae failed to construct a case even after an interval of over a week. In some cases this is believed to be due to an unhealthy condition of the larva; in others the negative response may reflect a differential ability in the handling of strange materials.

In addition to the effect of unusual materials on the time of onset and duration of construction in first experiments, the behavior of the larvae toward each different material in all experiments was considered. Descriptions of the material offered, the response of the larvae, and the cases produced with each material are given below.

The twig material used in experiments consisted of leaf petioles and small hardwood twigs ranging in diameter from 0.5–2.0 millimeters. These were soaked in water for a minimum of 24 hours prior to experiments. A total of ten larvae were presented with twigs. Of five larvae given twig material in December, four demonstrated cutting activity only after 10 days and none of the five succeeded in constructing twig cases. When these same larvae were subsequently given leaf material, all constructed cases, indicating that failure to utilize twigs was not due to the loss of the building instinct. Among five larvae given twig material in March, three were able to build twig cases. Although cutting of material was begun only after 18–28 hours, cases were completed in two days as shown in Table 2. Cut twig pieces incorporated in the cases were of unequal lengths and placed at irregular angles to the long axis of the case. Groups of twig pieces were frequently composed of parallel components but the groups themselves were irregularly placed with respect to each other. The degree of similarity between twig cases built by terminal instar larvae and those built by T-1 or T-2 instar larvae is shown in Figure 5. (In the terminology used here T refers to the termnial instar, T-1, T-2, etc. to preceding instars.) The closed length of the twig cases was somewhat shorter than the corresponding length of normal leaf cylinders built by the same larvae. In the twig cases constructed under experimental conditions, the posterior ends remained wide open in contrast to the leaf cases with posterior silk membranes.

"Water grass" (*Eleocharis*) consisted of threadlike pieces approximately 0.1 to 0.2 millimeters in diameter. Of 12 larvae given grass material, three failed to build cases. All three showed some cutting activity but were unable to assemble the material into the form of a case. Larvae were usually quite inefficient in handling the grass material and frequently many pieces were dropped and lost before being attached to larva or case. The time required for the construction of a girdle or belt with grass was 11–18 hours in contrast to the two to four hours consumed in the construction of a leaf belt. The completed grass cases were shorter than leaf cases constructed by the same larvae. The length of the grass cases ranged from 1.4 to 1.8 centimeters while corresponding leaf cases were 2.4–3.2 centimeters long. The interiors of the grass cases were smoothly rounded and, as with the leaf cases, lined with silk material. Two of the cases were closed at the posterior end by a silken membrane. Two experimental grass cases are illustrated in Figure 7.

Pine needles given to five larvae, consisted of clusters of white (*Pinus strobus*) and scotch (*Pinus sylvestris*) needles previously soaked in water several days. Only one larva succeeded in constructing a case. Of the remaining four, two appeared unhealthy several days following the start of the experiment and two had performed five or six previous experiments with other material. Additional experiments are required to determine the ability of the larvae to handle this material.

Sand utilized in six experiments consisted of whitish-gray aquarium sand sifted to include grain sizes ranging from 0.5–1.0 millimeters in diameter. After five days from the start of experiments, no larvae had built cases although two had fastened together about ten sand grains each. When a small leaf piece was added to each bowl, one larva attached a large number of grains to it but was unable to construct a case. All results were negative when the experiments were terminated at the end of ten days. It is thought that repetition of this experiment, which was carried out in late January, at a time closer to pupation or in the fall (when water temperatures of the natural habitat are warmer) might produce somewhat different results.

Preference.

In a series of experiments involving 30 larvae, the possibility that the larvae have a preference for one material over another was investigated. In one series of experiments larvae were presented with equal amounts of hickory (*Carya*), maple (*Acer*), and oak (*Quercus*) leaves. Larvae originally possessing leaf cases utilized hickory and maple leaves but failed to use oak in eight of eleven trials involving a total of nine larvae. One larva used a very small quantity of oak while the remaining two utilized all three leaf types in equal amounts. In repeat experiments, however, neither of these larvae incorporated oak in their cases. Twig case larvae also failed to use oak in their cases when given a choice of the three leaf types in equal amounts.

Two experimental larvae having some grass in their original cases showed a decided preference for grass when both leaf and grass material were offered. Larvae originally having leaf cases however, would utilize any leaf bits left in the bowl in preference to offered grass material.

When terminal instar larvae were given both leaf and twig material, new cases consisted almost entirely of leaf. During the later stages of construction two or three twig pieces might be loosely attached to the exterior of the case, but these were never cut into shorter lengths. Leaf builders presented with dead leaves and several three centimeter lengths of green *Vallisneria* leaves, used the latter readily and in one instance a case was constructed almost entirely of this material. Larvae occupying cases of strange material did not abandon these cases when normal material was again supplied, but simply cut and added pieces of normal material to their existing case. A pine needle case to which leaf pieces were added is illustrated in Figure 8.

Effect of larval age on case-building behavior.

The rate of construction by T-1 instar larvae, on the basis of observations on eight individuals, did not appear to be significantly different from that by terminal instar larvae. Additions to cases were made through the sixth and seventh days following the start of construction as was also occasionally true of mature larvae. Larvae building cases of the usual leaf material prior to pupation showed variation in the time between removal from case and start of construction from one to twenty-five hours and in total building time from two to seven days. Case-building by very early instar larvae was not observed and it is possible that their rate of construction would be much faster. There was no apparent correlation between rapid initiation of building and earlier completion of the case among 16 larvae observed. Nearly all of terminal instar larvae demonstrated an ability to construct new cases shortly before onset of pupation. This observation suggests that retention of the building instinct by *Nemotaulius hostilis* is much stronger than in certain species studied by Hanna (1960).

Modification of case prior to pupation.

The total lengths of cases built by experimental larvae just before pupation generally exceeded those of earlier larval cases and frequently included all material in the finger bowl. Following the construction of the case, the larva secreted a silk sieve membrane over one opening of the case. It then reversed its position in the case. At this stage several larvae extended their bodies out of the anterior end and moved actively around the bowl. After an interval of a few hours or more, the second membrane was constructed over the now anterior end and the larva remained within its case.

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AN ABDOMINAL ANOMALY IN A COREID (HEMIPTERA: HETEROPTERA), WITH SOME PHYLOGENETIC NOTES

By Carl W. Schaefer,[1] Brooklyn, New York

While looking over the Coreoidea in the collection of Dr. C. V. Reichard, I came upon a female *Anasa tristis* DeGeer in which the suture between the fourth and fifth sterna is incomplete laterally. The right side of the suture is normal, but on the left it curves anteriorly and fades out before reaching the connexivum (Figure 1). The anterior curvature is represented not by an intersegmental membrane, as occurs more medially, but by a slight internal ridge.

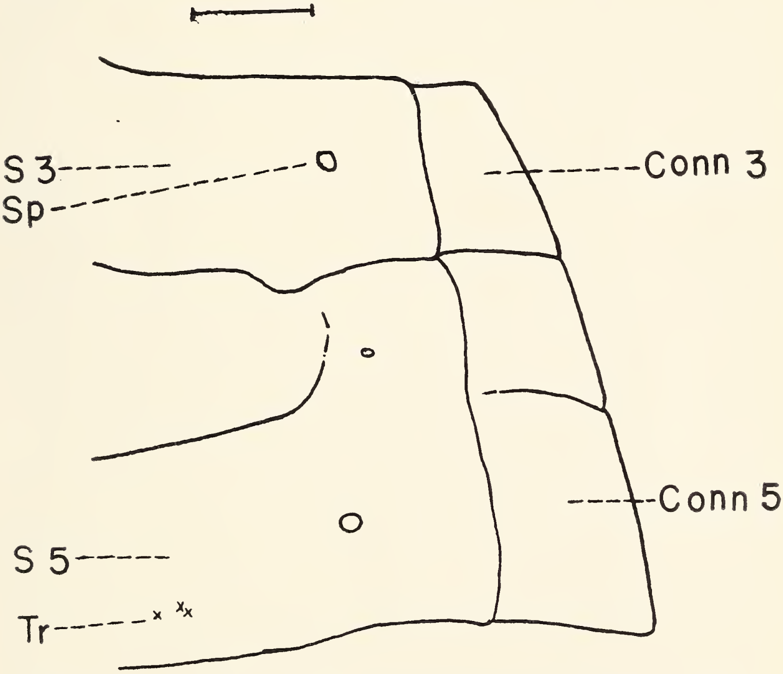

Figure 1. Ventral view, part of left side of *Anasa tristis* abdomen (connexivum flattened out). Conn 3, 5—connexival segments 3, 5; S 3, 5—sterna 3, 5; Sp—spiracle; Tr—trichobothrial cluster. The marker represents 0.77mm.

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[1] Department of Biology, Brooklyn College, Brooklyn 10, New York.

At a point opposite the termination of this ridge the posterior border of the third sternum curves posteriorly, but then continues its normal course. The fourth-fifth tergal suture is normal, but the suture between the fourth and fifth connexival segments ends abruptly before meeting the connexival-sternal suture; there is no ridge continuing the fourth-fifth connexival suture.

The opening of the fourth spiracle is very greatly reduced and is seen only with difficulty. The spiracular closing apparatus is missing. Despite this reduction of the spiracle, the tracheal trunk is large and certainly functional, although its diameter is only half that of the other segmental trunks. This trunk divides almost immediately after leaving the spiracle, instead of progressing somewhat more than a millimeter before bifurcating, as do the normal segmental trunks.

Because the fifth connexival segment and spiracle have not been displaced, it is clear this anomaly is either a disruption of the development of the intersegmental suture or an anterior migration of only that part of the fifth sternum lying anterior to the fifth spiracle. The lateral region of the fourth segment itself has not been shifted anteriorly to become incorporated into the anterior segment. Therefore, the anomaly does not resemble those of the cockroaches *Blattella germanica* (L.) (Ross & Cochran, 1961) and *Blaberus giganteus* (L.) (Fisk & Brass, 1961), in which lateral portions of tergites were absent, causing a twisted asymmetry. The *Anasa* is symmetrical, except for the abnormal course of the suture.

However, the anomaly is somewhat similar to the "helicomeries" illustrated by Balazuc (1951) in the pyrrhocorid *Pyrrhocoris apterus* L. Most of these anomalies are tergal and involve anterior or or posterior shifting of segmental boundaries, with some distortion of over-all symmetry.

The abdominal condition in this anomalous *Anasa* resembles that occurring normally in most of the Rhyparochrominae (Lygaeidae) and in the Physopeltinae (Largidae) (Scudder, 1963); in members of these groups too, the boundary between the fourth and fifth sterna curves anteriorly and fades out as it approaches the connexivum. In those rhyparochromines whose sterna bear spiracles, these are not displaced anteriorly; and in none is the fourth connexival segment displaced. The anomalous situation found here in *Anasa* thus superficially resembles the normal situation found in some other trichophorans.

Stys (1961) has suggested the bending of the fourth-fifth suture in the Rhyparochrominae is due to the migration of the anteriormost trichobothrium. The first of the three trichobothria of the fifth sternum is displaced anteriorly, and it is more probable this condition *reflects* an anterior movement of part of the fifth sternum than that it has *caused* this movement. Further clarification of this point awaits a detailed knowledge of these hairs' function and biological significance. The trichobothria in the Coreidae are more medial than they are in the Lygaeidae, and thus there is no trichobothrial displacement in this *Anasa.* However, the fact this displacement occurs in the Lygaeidae suggests that the anterior shift of the suture represents a true migration of part of the fifth sternum, and not merely a shifting of the fourth-fifth intersegmental suture.

Recently, Stys (1964) and I (1964) suggested independently that the Coreoidea (Stenocephalidae, Coreidae, Rhopalidae, Alydidae) and the Pyrrhocoroidea (Pyrrhocoridae, Largidae), arose from a lygaeid-like ancestor; Stys further suggests this ancestor was, or closely resembled, a rhyparochromine, a suggestion with which I agree. However, he states that the same rhyparochromine line may have been ancestral to both the coreoid and the pyrrhocoroid lines, and that this ancestor had straight sternal sutures. It appears to me more likely that the Pyrrhocoroidea arose from a rhyparochromine with curved sutures, and that this primitive condition is retained in the curved sutures of the more primitive (Schafer, 1964) pyrrhocoroid subfamily, Physopeltinae; sutures of the more advanced pyrrhocoroids have become straight. In the Coreoidea the sutures are always straight, even in the most primitive family, Stenocephalidae. (The Hyocephalidae—also with straight sutures—are closely related to the Stenocephalidae (Stys, 1964) and in my tentative opinion should be included with them; I do not make this formal, however, without further study of the group.) For many reasons (Schaefer, 1964) the Coreoidea could not have evolved from a pyrrhocoroid. I suggest therefore that the Coreoidea also arose from the Rhyparochrominae (or a rhyparochromine-like ancestor), but from a *different* group of them, a group in which all the sternal sutures were straight.

The anomalous occurrence of a coreid—the *Anasa* described here—with a curved sternal suture might suggest the rhyparochromine group ancestral to the Coreoidea also had curved sutures. This implies the abdominal anomaly is a "throwback" to an ancestral type, an implication I do not consider warranted on theoretical grounds and on morphological ones. There are too many structural differences between the suture in this *Anasa* and that in the Rhyparochrominae: the spiracular reduction, curving of the third-fourth suture, internal ridge, abrupt ending of the fourth-fifth connexival suture, and lack of bilateral symmetry are all unique to the *Anasa.* Finally, *Anasa tristis* belongs to an advanced tribe (Coreini) of the advanced coreoid family Coreidae (Schaefer, 1965), although a member (*Arhyssus lateralis* (Say)) of the least advanced coreoid tribe, Rhopalini, has been seen with a similar anomaly (Chopra, 1963, pers. comm.). I conclude that this anomaly in *Anasa tristis* is without phylogenetic significance.

ACKNOWLEDGEMENTS

I am grateful to Dr. C. V. Reichard (Providence College) for this specimen of *Anasa tristis,* and to Dr. J. A. Slater (University of Connecticut) for a specimen of the rhyparochromine *Ozophora picturata* Uhler.

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MIXED COLONIES OF ANTS ON LONG ISLAND, N. Y.

By Raymond Sanwald

Mixed colonies of ants, species *Lasius neoniger* Emery and *Acanthomyops murphyi* (Forel), were collected in my yard at Medford, Long Island. The habitat was dry sandy soil in an area that was cleared about twenty years ago. The ground cover is mostly grass with scattered Pitch Pine and Scrub Oak.

The first colony was taken on August 25, 1962, and the second on June 1, 1963. They were situated about 100 feet apart in typical *L. neoniger* habitat. Both colonies were small and few ants were found. I knew that the life history of *Acanthomyops* was not well known, but did not realize the significance of the discovery of mixed colonies at that time; so no deeper excavations were undertaken. As a result no queen, larvae or pupae were obtained. In both colonies the *A. murphyi* ants were smaller than ants in fully matured colonies. The *L. neoniger* also were smaller than normal, possibly indicating young colonies or ones in a marginal existence. At the time of collection both colonies were placed in a container as mixed units to make sure they could exist together and not just as neighbors. After living together for several days they were placed in alcohol.

Several years ago I unearthed a mixed colony of ants, which I realize now probably were *L. neoniger* and *A. murphyi*. The *A. murphyi* queen was taken with larvae of both species from this colony. They lived together for some time in a container and eventually were discarded.

Random observations of the post-flight activities of the *A. murphyi* queens shows that at times they "flood" the entrances of the *L. neoniger* nests trying to gain admittance. The *L. neoniger* workers attack the intruders. The young queens apparently offer no resistance, allowing themselves to be tugged at and dragged about. Often the *L. neoniger* plug the entrance against the invaders. This reaction has been noted at times with *Acanthomyops latipes* queens after nuptial flights.

Thanks are due Dr. M. R. Smith for identifying the ants collected and for bringing to light the mixed nature of the colonies.

THE USE OF EMERGENCE HOLES OF THE CICADA KILLER AS NEST BURROWS BY TACHYTES (HYMENOPTERA: SPHECIDAE)

By Norman Lin[1]

The use of pre-existing holes in the ground as nests by sphecid wasps is regarded by some workers as a primitive trait (Evans, 1958). Evans, however, points out that a great many more Sphecidae must be studied before this generalization can be confidently made. The following observations add another instance to the cases of such use already known.

A few sphecid wasps, *Tachytes elongatus* (Cresson), were found nesting in some aggregations of nests of the cicada killer (*Sphecius*

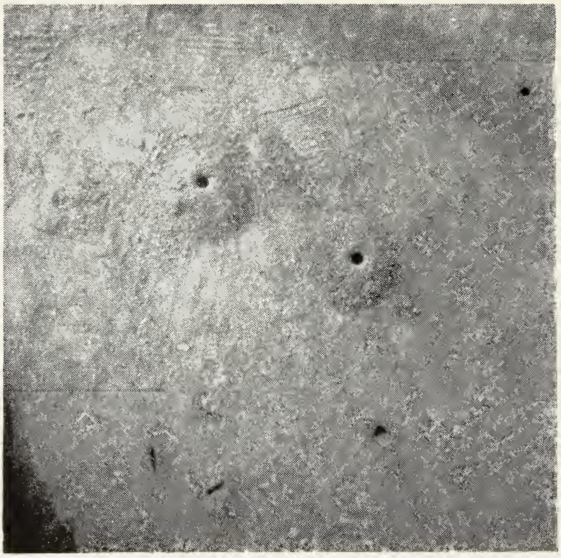

Fig. 1, the cicada killer (*Sphecius speciosus*) emergence holes with mounds around them have been converted into nest burrows by *Tachytes elongatus.*

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[1] Biological Laboratories, Harvard University. Current address Dept. of Zoology and Entomology, Ohio State University, Columbus, Ohio 43210. I am indebted to Dr. C. D. Michener of The University of Kansas for his constructive criticism of this paper and to Dr. K. Krombein of the U.S. National Museum for identification of the *Tachytes.*

speciosus Drury) in the Parade Grounds, a huge sandlot ball field in Brooklyn, New York. The emergence hole of the cicada killer, i.e., the exit tunnel made by a young wasp in escaping to the surface from its natal cell in the soil, is usually circular and about ten millimeters in diameter. It enters the ground vertically and varies in depth from about 2.5 to 30 centimeters. The nest burrow of *T. elongatus* is similar to the cicada killer emergence hole in the respects mentioned, except possibly for its depth which I have not investigated.

Observations made each year over a four season period (1958–61) have revealed frequent taking over of cicada killer emergence holes by females of *T. elongatus,* with reconstruction of these holes into nests. The emergence holes were usually discovered being used as nest burrows when mounds tumuli of earth from sources within the holes were found heaped around them. Sooner or later a *T. elongatus* was seen entering, provisioning, or digging in the nest. Figure I shows a group of four *Sphecius* emergence holes, two of which (with mounds) have been converted into nest burrows by *T. elongatus.*

It is known that this interaction is non-obligatory for *T. elongatus,* since some nests were constructed where there were no emergence holes. In addition, at least one case of a female *T. elongatus* beginning to dig a nest has been observed.

The interspecific relationship has been known on a few occasions to become one of protocooperation or mutual but non-obligatory benefit to both of the species. Male cicada killers set up territories, usually around emergence holes, next to or over which they perch. An important function of the emergence holes and territories is to localize the males in the regions from which the females will emerge, so that mating can take place on emergence. Since each nest potentially contains a number of young wasps, the emergence hole functions as a marker of a place from which new adult females will probably emerge from the nest in the ground (Lin, 1963). When an emergence hole is converted into a nest of *T. elongatus,* its life span as a hole is usually greatly increased, as is the likelihood of its continued function as a territorial perch for male *Sphecius.*

The utilization of cicada killer emergence holes as nest burrows by *Tachytes* probably appeared with the first contact between the two species. *T. elongatus* was probably already preadapted and utilized any holes with the appropriate specifications for its nest burrows. This behavior is known in several species of *Tachytes,* and H. E. Evans writes (in litt.) that he found *T. distinctus* nesting in lizard burrows in New Mexico. Williams (1913) in speaking in general of the Larrinae, the subfamily to which *Tachytes* belongs, found that on rare occasions they take advantage of cracks, and perhaps also of strange tunnels, to lessen the work of digging. Consequently such behavior is probably as old as the genus or even the subfamily.

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A NEW NORTHEASTERN CADDISFLY SPECIES OF THE GENUS *PHYLOCENTROPUS* (TRICHOPTERA: PSYCHOMYIIDAE)[1]

By David W. Root, Amherst, Mass.

This species was discovered by the author while doing a comparative morphological study of the males of *Phylocentropus* as a thesis project. The type specimen and two of the four paratypes are in the author's collections. One paratype will be deposited in the United States National Museum and another in the Canadian National Museum.

Phylocentropus hansoni, n. sp.

Only the male is known. The types are preserved in 70% alcohol and the drawings and measurements are from those specimens that were treated with KOH. The general structure is typical of the genus (Ross, 1965). My specimens are various shades of brown, somewhat darker than other members of the genus. The specimens treated with KOH show the same color patterns as the untreated ones but are notably lighter. The types vary in length from 7 to 11 mm.

Head: Dorsally heavily setose and dark brown except for medium brown warts; anteriorly light to medium brown; frontoclypeal setal pattern in the shape of a profile view of a short-legged stool.

Thorax: Dorsally dark brown except for medium brown warts; pleuron medium brown. *Legs* medium brown with the coxae slightly darker than the other leg regions. Wings all a uniform medium brown.

Abdomen: Tergites medium brown and sternites light brown. *Male genitalia* as in plate. Genitalia medium brown except for darker mediolateral ridge of clasper and darker color band of ninth sternite. Ninth tergite (Fig. 1) triangular in lateral aspect. Tenth tergite (Fig. 2) membranous, with shallow truncate notch medially and sides which slope ventrally and inflex to sclerotized bands terminating apically in four strong spines. Ninth sternite sclerotized except for a ventral membranous U-shaped area of variable extent, with anterodorsal projections serving as points of attachment for bases of cerci and ninth tergite. Cerci (Fig. 1) laterally flattened, with rough setose margins, attached dorsobasally to membrane of tenth tergite, distally expanding and apically broadly rounded. Clasper in lateral aspect (Fig. 1) with face above mediolateral ridge sloping mesally and with a dorsobasal concavity, with face below mediolateral ridge bearing long setae and with apical two-thirds distinctly concave, with apex truncate, with heavily sclerotized mediolateral ridge curving ventrally to form basal rim of clasper. Clasper in mesal aspect (Fig. 3) broad at base, tapering beyond its midpoint to a narrow truncate apex, with a very sparsely setose area set off between a sinuate row of short peg-like setae and an irregular band of short heavy setae, with a tuft of short heavy setae below apical lobe, with short fine setae on the apical lobe and clasper apex. Aedeagus a simple, slightly sinuate tube sclerotized except for its apical one-fifth, with an oval apicodorsal sclerotized plate which receives the sperm duct.

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Holotype male.—Paradise Trail, Sunderland, MASS., 25 May 1964 (D. MacKenzie and F. C. Thompson). Paratopotype male. Paratypes.—2 ♂♂, Mill River, North Amherst, MASS., 26 June 1964 (D. W. Root and C. H. Nelson). 1 ♂, oRute 3, NEW YORK, 8.5 miles west of Saranac Lake, 9.1 miles east of junction of routes 3 and 30, 15 June 1964 (D. W. Root and C. H. Nelson).

Discussion.—The description of this species brings the total number of living species in the placidus group to five (Ross, 1965). *Phylocentropus hansoni* is easily distinguished from the other species by: (1) having four apical spines on each of the lateral sclerotized bands of the tenth tergite; (2) the apical two-thirds of the ventral face of the clasper being concave; (3) a dorsobasal concavity of the clasper; and (4) a sparsely setose area between the peg-like row of setae and the irregular band of setae on the mesal face of the clasper. Many other good interspecific characters exist and these will be described when my thesis is published.

ACKNOWLEDGEMENTS

I name this species in honor of Dr. John F. Hanson for his invaluable aid in my development as a student and for his encouragement of my taxonomic interests in the Trichoptera. I would also like to thank Dr. Herbert H. Ross for the information he has provided concerning this project.

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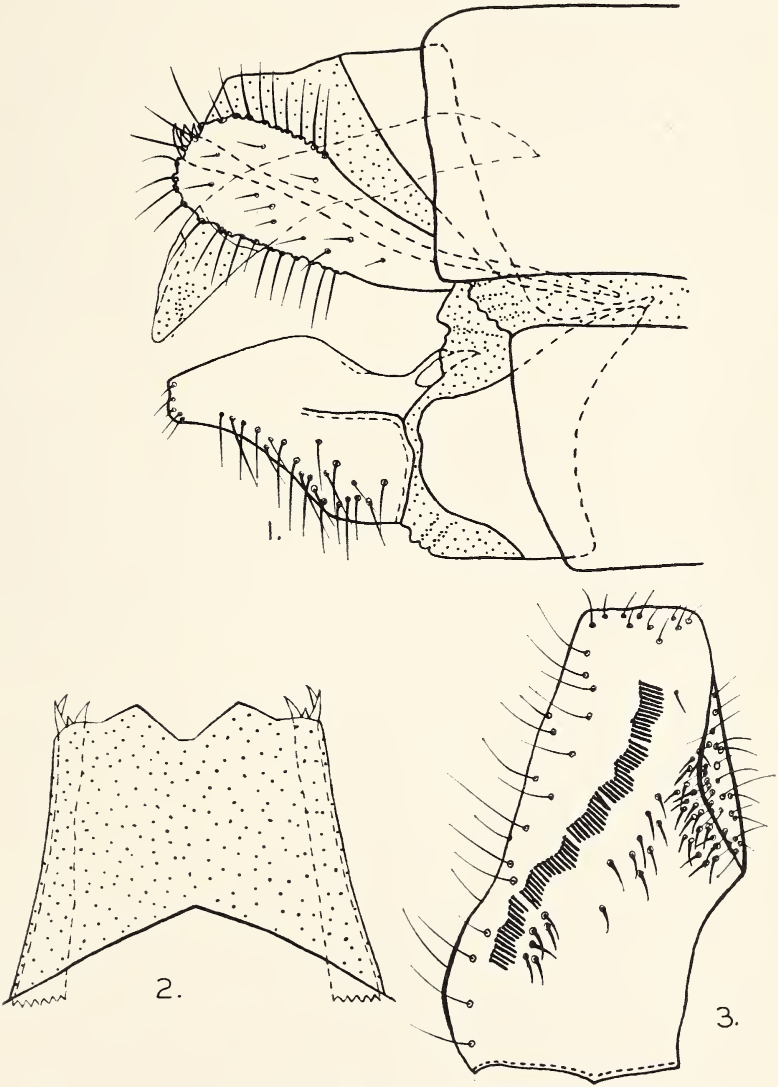

Figs. 1–3, Male genitalia of *Phylocentropus hansoni*. Fig. 1, male genitalia, lateral aspect. Fig. 2, tenth tergite, dorsal aspect. Fig. 3, clasper, mesal aspect.

THE FEEDING HABITS OF ALASKAN MOSQUITOES

By Cluff E. Hopla [1,2,3]
Norman, Oklahoma

INTRODUCTION:— In Alaska and other northern countries, the bloodsucking insects are represented primarily by two orders: Diptera (flies and mosquitoes) and Siphonaptera (fleas). The most offensive insect species to man and many other mammals are those belonging to the order Diptera, and of all the hematophagous creatures in this group, the slightly more than two dozen species of mosquitoes are probably the worst. Lesser offenders are: (1) Heleidae (punkies or no-see-ums) of the genus *Culicoides,* with six or more described species; (2) Simuliidae (black flies), consisting of approximately 36 described species; (3) Rhaginoidae (snipe flies) of two little-known species of the genus *Symphoromyia;* (4) Tabanidae (horse flies and deer flies), of uncertain number, possibly 24 species.

Since World War II, Alaskan mosquito investigations have provided a thorough insight into the taxonomy of this group. Among other things, these investigations have culminated in "The Mosquitoes of Alaska" by Gjullin, Sailer, Stone and Travis (1961). Frohne (see references) has laid the foundation for the bionomics of Alaskan mosquitoes. However, much still remains to be done. Virtually nothing is known about the disease transmission capabilities of boreal insects. Indeed, prior to this study, little had been learned about their feeding habits; a diligent search reveals a paucity of literature concerning host relationships other

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[1] Department of Zoology, University of Oklahoma.

[2] The studies upon which this paper is based were conducted in part under contract between the University of Oklahoma Research Institute and the Arctic Aeromedical Laboratory, United States Air Force. Support from the Faculty Research Committee, University of Oklahoma was invaluable in finishing this work.

[3] Numerous individuals have helped with this study and it is difficult to acknowledge all of them. The following research assistants have worked by my side through intolerably long hours in both the field and in the laboratory: R. D. Couser, J. H. Engleman, Mrs. Joyce Markman, C. S. Mitchell, and D. W. Trent. I am indebted to Dr. Alan Stone, USDA, and J. R. Vockeroth of the Canadian National Collection. Last, but not least, I am grateful to R. J. Sailer for an exchange of ideas concerning the feeding habits of Alaskan mosquitoes.

than man.

The biting habits of mosquitoes are of vital importance in their potential as vectors of disease organisms. By and large, most of the Alaskan mosquitoes are believed to be single-brooded. This has led many to suggest the possibility of a single feeding. If this were true, it would seem unlikely that insects which feed only once could transmit disease, since none of the insect-borne diseases currently known are transovarian in nature. To transmit disease organisms, the insect must feed at least twice, the last feeding upon man. It must be acknowledged, however, that there are times, through interrupted feedings, when it would be possible for mechanical transmission to play a role in the dissemination of a disease organism. Such a condition would only be a fortuitous one and would not likely happen with any regularity.

In an attempt to gain information regarding the above mentioned problems a multiple programmed investigation was undertaken during 1960–1962, dealing with the feeding habits in correlation with phenological data, seasonal variation in species populations, host selection, and laboratory studies concerned with colonization of certain species. Observations on the latter as well as the biology of Alaskan mosquitoes will be reported elsewhere.

CLIMATE AND GEOGRAPHY:—Climate has a direct effect upon invertebrate creatures such as mosquitoes and likely an indirect one upon the terrestrial vertebrate hosts on which they feed. The effect is indirect upon the host by determining the amount and kind of food that is available, as well as the protective cover. These factors largely determine distribution of the terrestrial mammals and also the mosquitoes.

The topography of Alaska exerts a strong influence upon the climate. The coastal mountains of the Alaska Range are not only the highest and some of the most massive mountains in western North America, but also stand directly in the path of warm moist air masses coming in from the Gulf of Alaska. Partly as a result of this, the amount of precipitation in the northern areas is considerably lower than that in southeastern Alaska. The Brooks Range is northern Alaska is lower, less massive, and faces the cold Arctic Ocean rather than the warmer Gulf of Alaska. The intermontane area between these two ranges of mountains is characterized by broad valleys or lowlands through which are interspersed small chains of mountains. For example, the Yukon Flats and the Tanana Valley lie between 400 and 600 feet in elevation and are drained by the Yukon River and its tributaries.

In light of the above discussion, climatic factors important to the mosquitoes and to their hosts should not only prove interesting, but also provide a better background for understanding the zoogeography of the mosquito. Various investigators have developed concepts attempting to relate such factors as the vegetation and the animal life. For purposes of this discussion, the work of Dice (1943), and that of Hopkins *et al.* (1955) are pertinent. These two studies were concerned with different problems, yet it was interesting to observe that the latter authors' "Zone of Continuous Permafrost" closely parallels Dice's Eskimoan Biotic Province; the "Zone of Discontinuous Permafrost" corresponds to the Hudsonian Biotic Province; and the "Zone of No Permafrost" is nearly congruous with the Sitkan Biotic Province.

Eskimoan Biotic Province:—This unique area is characterized by the nearly universal presence of permafrost. The soil thaws in the summer to a depth of 6 inches to 4 feet, depending upon surface material, vegetation cover, and exposure. The permafrost is perhaps the dominant ecological feature in the Eskimoan Biotic Province, thereby producing an entirely different flora and fauna, for without it, the Arctic Slope would indeed be a desert. Thienemann (1938) first postulated the importance of permafrost in the conservation of moisture in the Arctic. Natvig (1948) expounded more fully upon this.

The vegetation collectively is termed "tundra" and lies beyond the limit of tree growth, although tall willows, alders, and scattered poplars grow along the channels of the large streams in the southern part of the region. Tundra vegetation consists primarily of dwarf shrubs, grasses, sedges, lichens, and herbaceous plants. The word "tundra" is applied to a wide variety of vegetation types and is not a good indication of the presence or absence of trees. For example, Alpine tundra is considerably different from the tundra found beyond the Brooks Range or tree line. Areas of tundra vegetation are interspersed with forested areas throughout most of central Alaska, and both tundra and forest occur in all the permafrost zones, as well as in the zones of no permafrost.

As an example of the climate, let us consider Umiat. While Umiat is farther inland than Point Barrow, the climate is not remarkably different. The annual mean temperature at Umiat is 10° F, and the recorded extremes are 79° and –57° F. Mean annual precipitation is 5.4 inches, half of which is represented by rainfall during the months of July, August, and September. Annual snowfall is approximately 33 inches. Wind is a prevalent feature in this area and causes considerable drifting of the powdery snow that falls during the long, cold winter.

On the Arctic Slope (north of the Brooks Range), the mosquito fauna is limited to one genus and probably five species of mosquitoes. They are *Aedes communis* (DeGeer, 1776); *Aedes hexodontus* Dyar, 1916; *Aedes impiger* (Walker, 1848); *Aedes nigripes* (Zetterstedt, 1838); and *Aedes punctor* (Kirby, 1837). I do not mean to imply that these species of mosquitoes are found only in this region of Alaska, for they occur far to the south, some of them being reasonably abundant in the taiga. South of the Brooks Range there is a "fringing" of the taiga mosquitoes extending a short distance north of the tree line, such as I experienced at Anaktuvuk Pass in the summer of 1957, when I found *Culiseta alaskaensis* (Ludlow, 1906) breeding in rather large numbers around Summit Lake during the latter part of July. Although the habits and method of locomotion of mosquitoes and fleas are not at all similar, it is amazing the number of analogues that can be made in the distribution of these two groups of insects. Figure 1 illustrates a part of the terrain north of the Brooks Range.

Mammals frequently encountered, and more or less characteristic of this Biotic Province, follow. Some of these mammals are found to the south in the taiga; thus they cannot be truly characteristic of the province. Others, such as the hoary marmot (*Marmota caligata*) and the arctic ground squirrel (*Spermophilus undulatus*) are "characteristic" of the upland "tundra" throughout the montane areas to the south. For further accounts of arctic mammals, the reader is referred to Rausch (1953), Bee and Hall (1956), and Hall and Kelson (1959).

The aforementioned list of mammals in the Eskimoan Biotic Province includes: *Sorex arcticus* (arctic shrew), *Sorex cinereus* (masked shrew), *Lepus othus* (Alaskan hare), *Marmota caligata* (hoary marmot), *Spermophilus undulatus* (arctic ground squirrel), *Clethrionomys rutilus* (red-backed vole), *Dicrostonyx groenlandicus* (collared lemming), *Lemmus trimucronatus* (brown lemming), *Microtus miurus* (singing vole), *Microtus oeconomus* (arctic vole), *Alopex lagopus* (arctic fox), *Canis lupus* (gray wolf), *Vulpes fulva* (red fox), *Ursus horribilis* (grizzly bear), *Gulo luscus* (wolverine), *Mustela erminea* (ermine), *Mustela rixosa* (least weasel), *Alces alces* (moose), *Rangifer tarandus* (caribou), and *Ovis dalli* (Dall's sheep). The caribou probably is the most important animal in furnishing a blood meal for the "tundra" mosquitoes. The relatively recent arrival of the moose in the northern tundra regions provides an important additional host to the mosquito.

Hudsonian Biotic Province: This area is limited in the north at the tree line (spruce forests) on the south slope of the Brooks Range, in the south by the north slope of the Coast Range, and by altitude on various mountain systems in between. To most ecologists, this area is included in the "taiga." However, the taiga also includes the Canadian Biotic Province, which does not occur in Alaska. Therefore, the application of the term in this discussion is more restricted than usual. The Hudsonian is essentially transcontinental, stretching from Newfoundland to western Alaska, but is prevented from reaching the coastline by a narrow strip of tundra (Eskimoan Biotic Province). It reaches the Pacific Ocean only in a narrow strip at Cook Inlet.

On the south slope of the Brooks Range, the Hudsonian has many finger-like processes extending up into the low, protected valleys; likewise, it is penetrated by tundra along the mountain ridges at the higher elevations.

This is the "Zone of Discontinuous Permafrost," and the climate is characterized as a cold continental one (i.e., short, warm summers and long, cold winters). A large part of our study was conducted in the Tanana Valley, which is typified by data obtained in the Fairbanks environs, with a mean annual temperature of 26.1° F, and extremes of 99° F and – 66° F. The mean annual precipitation is 11.7 inches, 60% of which falls during the period from May to September as rain. The mean annual snowfall is 67 inches. The Tanana Valley has been subjected to considerable ecological disturbance. At first, this was due to gold mining operations, and this has been followed by attempts at homesteading for agricultural purposes and the production of rough lumber used in construction and housing needs. Military bases within the area have also changed the landscape. It is difficult to find virgin stands of timber because much of it has been burned over since the arrival of the prospectors about the turn of the century. However, some strands of white spruce that are 2½ feet in diameter can be found along the margins of streams.

Dr. Allan Mick, formerly an agronomist at the University of Alaska Experimental Farm, has informed me that the temperature of the soil varies considerably once the original cover is disturbed. For example, many of the plots in the experimental farm have shown a warming of 20° F since the ground was first cleared. Such a temperature change should have a remarkable effect upon the mosquito fauna, and it is believed that we have information to substantiate this point. The expansion of the highway system in Alaska is aiding the distribution of certain mosquitoes and mammals.

As more land is cleared within the Tanana Valley, a shift in the abundance of certain species of mosquitoes will no doubt occur. With the warming of the soil brought about by the clearing, such mosquitoes as *Aedes excrucians* and other banded-legged *Aedes* should increase in numbers and occur earlier in the year. *Aedes pionips* undoubtedly will increase also. However, proper drainage practices carried out with the clearing operations could cause a lessening of the populations.

The vegetation on undisturbed ground now consists of white spruce, paper birch, willow, balsam, poplar and some larch, growing in pure and mixed stands along rivers, sloughs, lakes and minor drainage courses. Birch, aspen and white spruce grow on bedrock slopes, hills and burned-over areas on glacial outwash plains. Dense, black spruce forest covers undisturbed areas on outwash plains. Upland valleys are covered by muskeg ("tundra" of some authors) consisting of sedges, grasses, dwarf birch, small heaths, or stands of stunted black spruce, willows and alder. As one becomes familiar with the area, one notes that stands of tall willows and isolated pure stands of balsam poplar on flood plains indicate the presence of unfrozen ground. Areas overgrown by black spruce are likely to be underlain by permafrost at a shallow depth. Throughout much of Alaska, the forests are limited to the slopes at lower altitudes and to the better drained parts of the valley floor.

Characteristic plants are: *Picea mariana* (black spruce), *Picea glauca* (white spruce), *Betula papyrifera* (paper birch), *Larix laricina* (tamarack or larch), *Populus balsamifera* (balsam poplar), *Populus tremuloides* (aspen), *Salix spp.* (willows), *Alnus incana* (alders), *Betula glandulosa* (dwarf birch), *Vaccinium* (blueberries), *Ledum groenlandicum* (Labrador tea), *Equisetum* (horsetail), *Eriophorium vaginatum* ("niggerheads"), and *Eriophorium scheuchxeri* (cotton grass). Low-bush cranberry frequently is abundant on well-drained slopes, particularly in mixed birch-spruce forests.

The animals encountered in the Hudsonian Biotic Province are not all characteristic of the taiga. Indeed, few mammals are confined solely to any one Biotic Province, although when occurring in more than one, they are not of equal abundance in both areas. For example, this is particularly true of the red-backed vole (*Clethrionomys rutilus*) and the wolverine (*Gulo luscus*), the former typically a taiga animal but with a broad distribution in the tundra. The latter is a tundra representative which occurs in lesser numbers in the taiga. Again I have listed certain animals, for example the arctic ground squirrel (*Spermophilus undulatus osgoodi* and *Spermophilus undulatus plesius*) as well as the pika (*Ochotona collaris*) and the marmot (*Marmota caligata*) which are usually associated with the upland areas, the last two being largely confined to talus slopes. *Spermophilus u. osgoodi* is particularly difficult to classify from this standpoint because it will occur in the lowlands, for example, along the Steese Highway from Central to Circle. In the Circle Hot Springs areas it has been observed in the aspen-spruce association. However, by far the greater preponderence of the population in the lowlands is in the cleared areas, thereby conforming in part to the major portion of the animal's range above timberline.

Thus, the following list of mammals is provisional, and I do not mean to imply that they are strictly taiga representatives: *Sorex arcticus* (arctic shrew), *Sorex cinereus* (masked shrew), *Microsorex hoyi* (pigmy shrew), *Lepus americanus* (varying hare), *Ochotona collaris* (collared pika), *Glaucomys sabrinus* (flying squirrel), *Marmota caligata* (hoary marmot), *Marmota monax* (woodchuck), *Spermophilus undulatus* (arctic ground squirrel), *Spermophilus undulatus osgoodi* (arctic ground squirrel), *Tamiasciurus hudsonicus* (red squirrel), *Castor canadensis* (beaver), *Clethrionomys rutilus* (red-backed vole), *Lemmus trimucronatus* (brown lemming), *Microtus oeconomus* (arctic vole), *Microtus pennsylvanicus* (meadow vole), *Ondatra zibethicus* (muskrat), *Zapus hudsonius* (jumping mouse), *Erethizon dorsatum* (porcupine), *Canis lupus* (gray wolf), *Vulpes fulva* (red fox), *Lynx canadensis* (lynx), *Ursus horribilis* (grizzly bear), *Ursus americanus* (black bear), *Gulo luscus* (wolverine), *Martes americana* (marten), *Mustela erminea* (ermine), *Mustela rixosa* (least weasel), *Mustela vison* (mink), *Alces alces* (moose), *Rangifer tarandus* (caribou).

Within this area I think the larger mammals such as moose, caribou, varying hare (when abundant) and the arctic ground squirrel provide the major source of blood meals in the taiga.

The taiga mosquitoes are: *Aedes canadensis* (Theobald, 1901); *Aedes cataphylla* Dyar, 1916; *Aedes cinereus* Meigen, 1818; *Aedes communis* (DeGeer, 1776); *Aedes decticus* Howard, Dyar, and Knab, 1917; *Aedes diantaeus* Howard, Dyar and Knab, 1917; *Aedes excrucians* (Walker, 1856); Aedes fitchii (Felt and Young, 1904); *Aedes hexodontus* Dyar, 1916; *Ades impiger* (Walker, 1848); *Aedes implicatus* Vockeroth, 1954; *Aedes intrudens* Dyar, 1919; *Aedes nigripes* (Zetterstedt, 1838); *Aedes pionips* Dyar, 1919; *Aedes pullatus* (Coquillett, 1904); *Aedes punctor* (Kirby, 1837); *Aedes riparius* Dyar and Knab, 1907; *Aedes stimulans* (Walker, 1848); *Anopheles earlei* Vargas, 1943; *Culex territans* Walker, 1856; *Culiseta alaskaensis* (Ludlow, 1906); *Culiseta impatiens* (Walker, 1848); *Culiseta morsitans* (Theobald, 1901). Most important of these mosquitoes are *Aedes intrudens, Aedes punctor, Aedes excrucians,* and *Culiseta alaskaensis.*

Sitkan Biotic Province:—This occupies most of what is known as the "panhandle" or southeastern Alaska. The climate is characterized as being cool but equable. For instance, January is usually the coldest month, and it is seldom that the temperature is lower than 32° F; July is the hottest month, and the average temperature is 57.5° F. The maximum recorded temperature of 96° F, and a minimum of –8° F have been recorded at Ketchikan. The temperature is surprisingly uniform for such a long, relatively north-south strip of land. For example, during January the average temperature at Juneau is 27° F, while the hottest month, July, has an average temperature of 56.6° F, with a range of from –15° to 89° F. The precipitation, however, is more variable. The average annual precipitation at Ketchikan is 150.89 inches, with May, June, and July being the driest months. Juneau has an average annual precipitation of 83.25 inches, with a similar dry spell. Average snowfall approximates 100 inches annually.

This area was extensively glaciated during the Pleistocene, and many large glaciers still occur. Timberline ranges between 1,000 and 2,000 feet as a general rule, but may vary from 500 to 3,000 feet. The Sitkan Province is extremely mountainous; much of it is broken by the sea into chains of mountainous islands, which in turn are separated by tide-swept channels. The boundaries for the Sitkan Biotic Province are somewhat arbitrary; however, it is generally limited to the heavy coastal coniferous forests which extend from near Kodiak Island southeastward to the southern tip of Alaska. In an eastward direction, the boundary between the Sitkan and the Hudsonian Province is placed along the top of the Coast Range. (In early studies this range included what are now known as St. Elias Mountains and the Coast Mountains.)

The most important or characteristic trees in the heavily forested areas at the lower elevations are: *Chamaecyparis nootkatensis* (Alaskan cedar), *Tsuga heterophylla* (western hemlock), *Tsuga mertensiana* (mountain hemlock), *Picea sitchensis* (sitka spruce), *Salix spp.* (willow) and *Populus tricocarpa* (black cottonwood).

Some of the characteristic mammals are: *Sorex obscurus* (dusky shrew), *Sorex palustris* (water shrew), *Myotis lucifugus lucifugus* (little brown myotis), *Spermophilus undulatus* (arctic ground squirrel), *Tamiasciurus hudsonicus* (red squirrel), *Peromyscus maniculatus* (deer mouse), *Phenacomys intermedius* (mountain phenacomys), *Microtus longicaudus* (lond-tailed vole), *Microtus oeconomous macfarlani,* (tundra vole), *Clethrionomys rutilus* (red-backed vole), *Erethizon dorsatum* (porcupine), *Ursus horribilis* (Alaskan brown bear), *Mustela vison* (mink), *Mustela erminea* (ermine), *Alces alces* (moose), and *Dama hemionus* (black-tailed deer).

From what is known of the siphonapterous fauna of this region, the species are more representative of the Pacific Northwest than they are of the Hudsonian or Eskimoan Biotic Provinces. This seems truly amazing when it is observed that the mosquito fauna is representative of the two northern Biotic Provinces. At first glance it would seem that the mosquitoes would have a better chance to invade the southeastern part of Alaska from the south (Pacific Northwest) than the fleas. Perhaps the most valid conclusion that can be drawn from the above evidence is that not enough data have been accumulated for either the fleas or mosquitoes!

Any attempt to explain the biogeography of southeastern Alaska should take into account the recent recession of the glaciers there and the comparative isolation still caused by sea, ice and mountain barriers. However, radio-carbon dating (Berrill, 1958) shows no such great age difference from the north temperate United States as one might expect. For example, much of Maine was still covered by the Wisconsin Glacier for about 1,000 years after the bog on upper Montana Creek near Juneau melted and began accumulating peat about 5,000 years ago (Heusser, 1952). However, this geologically short period, operating in conjunction with the barriers mentioned above and the lengthy (although mild) winters in southeastern Alaska, has combined to keep many organisms out of the area up to the present time. Some mosquitoes, for example, *Culiseta alaskaensis* and *Aedes excrucians,* have been able to penetrate into the region only as far as Haines and Wrangell, where major rivers have provided an avenue from the interior. However, along the coast and perhaps by island-jumping, two mosquitoes, *Culiseta incidens* and *particeps,* have penetrated northward. These last two mosquitoes are otherwise typical of the West Coast temperate forms in the lower 48 states. A further factor is the cool summer climate of southeastern Alaska.

The region is relegated to the temperature of the temperate zone in recognition of its mild winters, despite its cool summer climate. In comparing the list of the mosquitoes of this region with that of the Hudsonian, it is interesting to note that the genus *Anopheles* is not represented in the so-called "temperate" region of Alaska.

According to Frohne (1954), there are no mosquitoes in this area which produce more than a single annual brood. The mosquito biting season is long, over 5 months. The absence of *Culex* and *Anopheles* suggests that the southeastern mosquito fauna is of the Arctic type rather than a temperate one, as one ordinarily would expect.

The mosquito fauna of the Sitkan Biotic Province is thought to consist of approximately 12 species. Except for the report by Frohne, 1954, only meager information is available. A more thorough study of the fauna is needed in this region and would undoubtedly increase the number of species known. The species reported thus far are: *Aedes aboriginis* Dyar; *Aedes cinereus* Meigen; *Aedes communis* (DeGeer); *Aedes excrucians* (Walker); *Aedes pionips* Dyar; *Aedes pullatus* (Coquillett); *Aedes punctor* (Kirby); *Culiseta alaskaensis* (Ludlow); *Culiseta impatiens* (Walker); *Culiseta incidens* (Thomson); *Culiseta morsitans* (Theobald); *Culiseta particeps* (Adams).

According to Jenkins (1958), the mosquitoes of the Boreal Region consist of 36 species. The distribution of these mosquitoes is summarized in Table I. From the information presented here, it would seem that North America has a larger fauna, but this is not necessarily the case. The difference in the number of species is more than likely due to a difference in taxonomic approach in the two areas. For example, many Eurasians workers have not concurred with the splitting of the *Aedes communis* complex to the extent that has been done by North American workers. Some difference is also bound to have occurred because of the emphasis placed on the northern mosquitoes in our own fauna since World War II.

TABLE I. Distribution of the Boreal Mosquito Fauna.
(Total—36 species)

Region	Number of Species
North America	30
Eurasia	22
Holarctic	20

LIFE CYCLE:—Alaskan mosquitoes can be placed in two groups, depending upon their life cycles. Wesenberg-Lund (1920–21) established four types of life cycles for the mosquitoes of the world; these four have withstood the test of time, except for one modification to be mentioned below. The first type, the *Aedes cinereus* type of life cycle, is typified by all Alaskan *Aedes,* in which hibernation or overwintering takes place solely in the egg stage. The eggs, larvae and sometimes pupae, are cold-tolerant forms. This is the only type of life cycle known for those mosquitoes which inhabit the Arctic Slope. A fifth type of life cycle was proposed by Frohne, (1953, 1954), in which hibernation is accomplished in the adult stage. This differs from the fourth type described by Wesenberg-Lund (1920–21) and by Bates (1949) because although the females are inseminated before hibernation, they do not seek a blood meal at this time. Recent information indicates this behavior may be true for many mosquitoes of the temperature region. Frohne further believed that the mosquitoes with this type of life cycle were again single-brooded. To this latter type of life cycle belong all of the Alaskan mosquitoes that are placed in the genera *Anopheles, Culex* and *Culiseta.* These constitute a very small proportion of the total mosquito fauna in Alaska.

Much has been said about the cold-hardiness of Alaskan mosquitoes without the writers really understanding the actual ecology. Pruitt (1957) reported on temperatures beneath the snow in Alaska, and it is extremely significant that once 19 cm of snow have been accumulated on the ground, the temperature next to the earth does not get lower than 16° F. These studies were conducted in the taiga, and it is thought that such a temperature would likely be found throughout most of the alpine regions of the Rocky Mountains. Most individuals have had a common concept that the mosquitoes and their eggs were surviving the winter exposed to the extremely low temperatures that are known above the snow cover. From information now available (that will be reported in more detail), we now know that the adults of *Culiseta alaskaensis* and those of *Culex territans* hibernate below the snow in clumps of *Calamagrostis* grass very close to the ground. I have never found that these adult mosquitoes are able to withstand temperatures below 0° F in the laboratory for any prolonged period of time.

BITING STUDIES:—Among the many facets of this investigation, none are so germane to all others as the study of the biting habits of boreal mosquitoes. Considerable controversy abounds concerning the number of times boreal mosquitoes may seek a blood meal or if one is actually required for the maturation of eggs. No careful studies have been completed concerning the host preferences, if indeed such a phenomenon exists. Regardless of what diseases these northern mosquitoes might carry, their feeding habits are such that no other group of animals serves as such a strong deterrent force to man's living in this region of the world.

Apparently, the mosquito problem in Alaska has changed very little since it was first recorded by early travelers and explorers. I do not mean to imply that the mosquito season is the same each year, because it does vary with the abundance of the total population and with the dominance of a given species in any one year. There are times in Alaska when the mosquito population is not any greater than it is in any part of the temperate region; however, in some years the mosquitoes have occured in intolerable numbers and thus have accounted for some graphic writing by early explorers. The following brief accounts by three early scientists are given here because they provide something of an insight as to what the situation was in Alaska and other northern regions before the invasion by European populations.

In 1880 Petrof investigated Alaskan resources and later published his findings. He found the mosquitoes to be an extremely severe annoyance in the Kuskokwim Valley, as indicated by the following brief excerpt from his writings:

> "There is another feature in this country which, though insignificant on paper, is to the traveler the most terrible and poignant infection he can be called upon to bear in a new land. I refer to the clouds of blood-thirsty mosquitoes, accompanied by a vindictive ally in the shape of a small poisonous black fly, under the stress of whose persecution the strongest man with the firmest will must either feel depressed or succumb to low fever. . . . The traveler who exposes his bare eyes or face loses his natural appearance; his eyelids swell up and close, and his face becomes one mass of lumps and fiery pimples. Mosquitoes torture the Indian dogs to death, especially if one of these animals, by mange or otherwise, loses an inconsiderable portion of its thick hairy covering, and even drive the bear and deer into the water."

Abercrombie (1900) camped several days in the area that is now known as Copper Center, and he reports on the mosquito populations for that time of the year (June 9–13) as follows:

> "The long expected pests, the mosquitoes, were out in full force, during this day at this camp, and the men were compelled to wear veils day and night with gloves to protect the hands. The ferocity of these mosquitoes is regarded as something remarkable. The species found here is not the large, singing sort seen in the States, but a small, silent, business-like insect, sharp of bill, who touches a tender spot in a surprisingly short time after biting. After making their appearance, they never left the expedition for a day."

Seton (1911) gives an account of his experiences in the Barren

Grounds of Canada. He reports:

> "Each day they got worse; soon it became clear that mere adjectives could not convey any idea of their terrors. I therefore devised a mosquito gauge. I held up a bare hand for five seconds by the watch, and counted the number of borers on the back; there were five to ten. Each day added to the number and when we got to the buffalo country, there were fifteen to twenty-five on the one side of the hand and elsewhere in proportion. On the Nyarling, in early July, the number was increased, being now 20 to 40. On Great Slave Lake, later that month, there were 50 to 60. But when we reached the Barren Grounds, the land of open breezy plains and cold water lakes, the pests were so bad that the hand held up for five seconds often showed from 100 to 125 long-billed mosquitoes boring away into the flesh. It was possible to number them only by killing them and counting the corpses. What wonder that all men should avoid the open plains, that are the kingdom of such a scourge."

The above account by Seton is the only one known to me in which the numbers of mosquitoes were actually counted. If the mosquitoes in Seton's account were to continue to bite at the same rate, they would total approximately 18,000 mosquitoes for a 15-minute period! This is the interval that we used to obtain our information regarding the biting habits of Alaskan mosquitoes, and we never approached nearly as high a figure. What I considered intolerable numbers of mosquitoes were encountered at the mouth of the Anaktuvuk River in July of 1962. At this time, we secured 1,253 mosquitoes.

Taiga Mosquitoes; Twenty-four Hour Biting Studies:— These particular studies were done to obtain information about the effect of seasonal change on the species complex encountered in the taiga, and to determine if and to what extent climatic conditions influence the biting rate or feeding habits of these insects. White laboratory rabbits and human volunteers were used as bait. The ventral surface of the rabbit was shaved, and an area of 54 square inches (9 × 6 inches) was outlined with a marking pencil. The rabbit was then immobilized on a board and completely covered with a heavy burlap material for a period of 20 minutes to prevent the mosquitoes from feeding upon it. An identical area on the forearm of a human volunteer was utilized.

The 20-minute period was necessary to obtain phenological data prior to the feeding. This included temperature, relative humidity, wind velocity, and light. The correlation of these factors to feeding is described in a separate section. In addition, it allowed the mosquitoes to settle to a more or less normal activity after being disturbed and attracted to us in abnormal numbers as we walked through the woods to the study site. Biting samples were conducted for 15 minutes, and all the biting insects were collected with an aspirator and placed in killing tubes. Only those insects which had inserted their proboscises and showed some distention of their abdomens were taken. Insofar as I know, this is the only time that such a method has been utilized, but our preliminary studies had indicated that the "landing rate" method used by earlier workers was not of significant value, since many of the mosquitoes would land on one's clothing and fly away without attempting to feed. We noted this to a disturbing degree even upon the exposed forearm of man and on the shaved ventral surface of the rabbit. Such biting studies were conducted weekly at 2-hour intervals over a 24-hour period. The studies were conducted 34 to 36 inches above the ground, because preliminary experiments had indicated this was close to the optimum elevation for subarctic mosquitoes.

Coveralls of the same material and color were provided for all personnel involved in this study. Sets of gloves and headnets were set aside especially for this use, in order to have as uniform a condition as possible. Preliminary studies had indicated that dark colors, such as red or green, would attract a good many more mosquitoes to the same person than when he was dressed in light colors.

The principal area used for the biting studies was a wooded site adjacent to Peede Road, approximately 7½ miles southeast of Fort Wainwright. This study area was granted to us by Mrs. A. H. Nordale, and hereafter in this discussion it will be referred to as the Nordale study site. The forest cover was perhaps as close to a virgin stand of white spruce as one could find within a radius of 50 miles of Fairbanks. There were a few paper birches and cottonwood trees intermingled with the spruce; the forest floor was covered with a deep layer of various species of mosses. This site was picked because it was relatively undisturbed ecologically; no trees had been removed from the area for about 50 years. At least, this was true at the beginning of the study; some trees were taken out during the spring of 1962, but this operation was stopped as soon as it was known that we wanted to continue our studies in 1962. Another factor influencing our selection of the site was that it would not be influenced too rapidly by minor climatic changes, and studies in the past had indicated that through the years it had as heavy a population of mosquitoes as could be found anywhere in the Fairbanks vicinity. Generally, in the heavy spruce forest the mosquito season seems to last a week or so longer than in the open area or in the stands of secondary growth.

Table II summarizes the data collected from the biting studies utilizing rabbit abdomens and forearms of human volunteers. There were 9,466 specimens obtained during the two seasons, and as indicated in this Table, there was a higher average biting rate per period from the human host than from the rabbit. In fact, the average was almost double.

TABLE II. Average Number of Mosquitoes Biting During a 15 minute Period

Host	Average per Biting Period 1960	 1961
Forearm (Man)	54.17	69.23
Rabbit	24.11	32.13

The maximum number from one feeding period was 350 from the man and 194 from the rabbit. It must be kept in mind that while the mosquitoes were only allowed to feed on areas of the same size in both rabbits and men, the mass of the human body exuding carbon dioxide and heat was far larger than the total mass of the rabbit. This was perhaps partly responsible for the difference in the data obtained. A breakdown by species did not reveal any significant shift between these two hosts. In other words, the same species were dominant upon both. In order of abundance were *Aedes excrucians, Aedes punctor, Aedes intrudens* and *Aedes pionips.* Inasmuch as the studies did not start until shortly after the first of June these two years, the peak for *Culiseta alaskaensis* had already passed and only an occasional specimen of this mosquito was encountered. Several other species were met more or less routinely, but they did not make up anywhere nearly so great a proportion of the biting records as either of the four species of *Aedes* mentioned above. It may be well to note, however, that *Aedes stimulans* was at times reasonably abundant, as was *Aedes communis.*

Quite by accident during the summer of 1959, while carrying out some investigations at the Wilbur Creek study site, it was observed that as one progressed upward in elevation from the ground, the biting records decreased considerably above 18 feet. This was checked occasionally during the summers of 1960 and 1961, and consistently the same results were obtained. This concept and the literature dealing with inversion factors of temperature and mosquito behavior in recent years made me decide to erect a tower that would be high enough to reach the average height of the trees in a forested area. Figure 2 shows the tower that was constructed to study the vertical distribution of mosquitoes. Insofar as I know, this was the first serious attempt to obtain biting records by this method in the subarctic. Figure 3 shows one of the bait boxes, as well as a box which housed a hygrothermograph.

The tower utilized three white spruce that were standing upright from each other in a triangular position. The platforms were placed at 6-foot intervals and were triangular in outline. The highest platform was 42 feet above the group. A fourth tree had grown adjacent to one of the trees and was close enough to be used for the construction of a ladder. To give some additional steadiness to the tower, guide wires were run down from near the top of each tree. The tops of the trees were chopped off.

Host studies revolved around standard white laboratory rabbits, varying hares and domestic chickens. On rare occasions native gallinaceous birds (willow ptarmigan and ruffed grouse) were utilized. Each type of host was placed in the bait box at each level for a 24-hour period; at the end of this time the mosquitoes were removed with an aspirator and the host was taken out of the bait box. A period of 12 hours was then allowed to elapse before a different host was placed in the box, and one 24-hour period was tested when the boxes were empty, to serve as a control. Figure 4 shows one of the bait boxes in considerable detail. The wooden door would slide back for insertion of the host animal; the netting prevented the mosquitoes from gaining entrance during this operation and prevented them from escaping after being attracted into the box by the host. The varying hare, because of its excitability, had to be restrained within a small, hardware cloth cage which permitted movement but prevented it from damaging the screen "V"-shaped baffles at each end of the box. These baffles allowed the mosquitoes to enter but not to escape. Preliminary studies indicated that the outside color of the bait box made little if any difference in the capture rate; therefore, all were painted white to make them easier to see.

Table III represents the mosquitoes taken during the summer of 1962 from the various animals that were routinely used. A significant point is the drop in the total number of mosquitoes taken beyond the 18-foot level. To check this further, we stationed human volunteers on each platform for 1-hour intervals several times throughout the course of the study and obtained essentially the same results. During the height of the mosquito season, one never needed to worry about the mosquitoes on the highest three platforms; it was perfectly enjoyable to be there without any protective measures and not receive more than an occasional bite. Within the taiga, I feel this is of practical significance, since as a person lost and without protection from the mosquitoes at ground level could secure reasonable freedom from them if he were able to climb high enough in a tree. There are times when this could possibly mean the difference between survival and death.

In an effort to check the mosquito populations adjacent to Nordale Woods, professional insect nets were utilized in a sweeping fashion describing an arc of 180° in front of the investigator and in the vegetation. This was done in an effort to determine whether the species we were getting in the biting studies were indeed a true cross section of the mosquito population in the area. Cursory classification of mosquitoes has indicated that our biting specimens were indeed a valid cross section. Of 46,123 mosquitoes captured this way, six were encountered that showed evidence of a previous blood meal. Figure 6 graphically portrays part of the results presented in Table III. It is evident from this figure that the varying hare was more attractive to the mosquitoes than either of the other animals used. From this figure, one would be led to believe that the domestic chicken was reasonably attractive to the subarctic mosquitoes; however, an examination of the percentage of the mosquitoes that were engorged in the bait boxes housing the chickens (Figure 7) shed quite a different light on the matter. Only 18.2% were engorged, compared to 70% for the laboratory rabbit and 92% for the varying hare. This would be in agreement with the studies carried out by Downe (1960), who concluded that the chickens were quite unattractive to the mosquitoes.

TABLE III. Number of Mosquitoes Attracted to the Various Hosts at Different Levels on the "Mosquito Tower."

	Distance from Ground	Laboratory Rabbit	Domestic Chicken	Varying Hare	Control	Total for Level
Ground	6″	811	733	1,250	156	2,950
p.1	6′	823	477	960	150	2,410
p.2	12′	580	481	853	95	2,009
p.3	18′	420	319	592	60	1,391
p.4	24′	264	240	370	7	881
p.5	30′	276	81	223	10	590
p.6	36′	90	63	180	5	338
p.7	42′	63	41	93	6	203
TOTALS		3,327	2,435	4,521	489	10,772

TABLE IV. Predominant Mosquitoes Encountered for the Various Hosts When Studying Vertical Distribution. They are listed in order of abundance.

Rabbit	Varying Hare	Domestic Chicken
Aedes excrucians	*Aedes intrudens*	*Aedes excrucians*
Aedes intrudens	*Aedes excrucians*	*Aedes intrudens*
Aedes pionips	*Aedes punctor*	*Aedes hexodontus*
Aedes communis	*Aedes stimulans*	*Aedes punctor*
Aedes punctor	*Aedes communis*	*Aedes communis*

The above information is particularly interesting when one reviews the records of Natvig (1948), who recorded various species of mosquitoes attacking nestling birds in Norway. According to Natvig, *Aedes punctor* was observed feeding on a sparrow hawk, *Aedes communis* on grouse, and *Aedes excrucians* and *Aedes intrudens* on the golden eagle. Natvig also reported the following nestling birds were attacked by unidentified species of mosquitoes: the rough-legged hawk, rook, crow, gull, lapwing and kestrel. Thienemann (1938) recorded *Aedes punctor* and *Aedes communis* feeding on voles and lemmings, and he indicated that these animals probably constituted the principal source of blood meal for the mosquitoes in the Scandinavian Arctic. Longstaff (1932) has reported *Aedes nigripes* feeding on the redpoll and possibly on the arctic hare in Greenland.

The observations of the above-mentioned authors in regards to the avian hosts are in distinct contrast to what I have noted during the several summers that I have been in Alaska. During several hours of watching a mealy redpoll (*Acanthis flammea flammea*) through the nesting period, no mosquitoes were ever observed to feed upon her. Eventually one could stand as close as 12 inches from the nest and have innumerable mosquitoes attempting to attain a blood meal from oneself; yet none were noticed seeking a meal from the redpoll. After the eggs had hatched, one could stand immediately adjacent to the nest and observe the same nonbiting phenomenon with the nestlings. I have noticed the same reluctance of mosquitoes to feed on young flickers whose bodies were essentially nude; they could be placed in the open, and apparently the mosquitoes paid little or no attention to them. I have made this same observation with white-crowned sparrows, yellow warblers, olive-backed thrushes, and rusty blackbirds. I realize that my studies are not exhaustive enough to say irrevocably that the birds are not important, but I have a strong feeling that they do not contribute significantly to the feeding requirements of subarctic mosquitoes.

With regard to Thienemann's report (1938) regarding voles and lemmings, I also feel that this is an untenable concept. The voles and lemmings generally are most active during the cooler part of the 24-hour cycle, and frequently this temperature is below the level at which the mosquitoes do most of their biting. Certainly the voles are moving through the vegetation so rapidly that the mosquito has little or no chance to stay on them long enough to become engorged. Most likely, at least through my observations, the mosquitoes would be brushed off as the rodent passed through the vegetation. On the other hand, I have observed the arctic ground squirrel and know that on windless days in the tundra regions (Arctic Slope) the mosquitoes can make life literally as unpleasant for this rodent as they do for the human observer. The same observations have been made in the upland tundra above the Hudsonian Biotic Province. If a rodent is important, then probably this one animal constitutes a reasonably good source of food.

Among the lagomorphs, the varying hare in the taiga region feeds a large number of mosquitoes. When this hare is in abundance, the subarctic mosquitoes have an ample opportunity to obtain a blood meal. I have watched these mosquitoes feed on the hare at relatively close range, and with the aid of field glasses, have been able to count as many as 25 mosquitoes in various stages of engorgement on one ear. Frequently, in what would ordinarily be the crepuscular period at lower latitudes, varying hares will sit along side of the road or in open areas for variable lengths of time with swarms of mosquitoes around them. Occassionally they will brush their ears and noses with their forepaws, possibly in an attempt to free themselves from some of the mosquitoes. When the varying hare population is low, then it cannot contribute a significant amount to the feeding ecology of subarctic mosquitoes, and there are as many "lean" years for this mammal as there are years of abundance.

Certain mammals, such as the caribou and the moose, are found within the taiga, but I have never had an opportunity to observe a sufficient number of these animals at close range to ascertain how important they might be as a source of blood for the mosquitoes. I have observations of one caribou in the arctic tundra which I will mention later, but this is an isolated case that I think unsafe to transliterate from the tundra to the taiga. I have had trappers and big game guides tell me that they have seen moose very distracted by the persistent attacks of mosquitoes, and I can well imagine that this is so. During earlier years at the Arctic Aeromedical Laboratory, several bears were housed in cages, and I know that *Aedes communis, Aedes punctor, Aedes excrucians* and *Culiseta alaskaensis* would feed on these animals with considerable avidity.

Arctic Mosquitoes: To obtain information about the feeding habits of arctic mosquitoes, the following study in the field was undertaken. It was decided to go by rubber raft along the Colville River from Umiat to where it empties into the Arctic Ocean. To make such a trip feasible, I am deeply indebted to the administration of the Arctic Aeromedical Laboratory for releasing MSgt. Freeman White and SSgt. James Williams to assist me in this endeavor. Sergeant White had had previous experience in the area and without his knowledge in handling the rubber rafts and knowing the Colville, the trip would not have been possible. This study was slightly more than two weeks in duration and was scheduled for the middle of July, a time thought to coincide with the peak of the arctic mosquito season. Feeding observations were made at Umiat for a period of three days, at the mouth of the Anaktuvuk River one day, at Big Bend one day, Ocean Point three days, and the mouth of the Colville River six days. From these studies, data were obtained for the basis of the concept that five species constituted the mosquito population of the Eskimoan

TABLE V. Twenty-four Hour Biting Study at Umiat, Alaska, July 28, 1962. Note greater activities of mosquitoes as compared to that of Tables VI and VII.

Time	Temp.	Relative Humidity	Foot Candles	No. Mosquitoes
0200	34	80%	200	0
0400	33	91%	300	0
0600	35	87%	500	6
0800	42	76%	800	125
1000	45	72%	850	183
1200	50	35%	1000	225
1400	60	30%	1000	350
1600	61	32%	1000	330
1800	58	34%	850	980
2000	55	41%	725	737
2200	48	65%	450	260
2400	42	70%	350	30

Biotic Province. At the first three collection sites previously mentioned, all five species were encountered. However, at Ocean Point, *Aedes impiger* and *Aedes nigripes* were the most abundant, with *Aedes punctor* and *Aedes hexodontus* performing a relatively insignificant role. No specimens of *A. communis* were observed there. Man was used as the attrahent host in all cases. The densest population of mosquitoes (Figure 8) that I have ever encountered in either the arctic or subarctic was at the mouth of the Anaktuvuk River. During a 15-minute interval, 1,253 mosquitoes were removed from the forearm of an experimental subject. This was an area corresponding to the 54 square inches mentioned previously in the biting studies at Nordale Woods, and the feeding rate was approximately four-and-one-half times greater than the highest number ever encountered in the subarctic.

Upon arrival at the mouth of the Colville River, we learned that there had been no strong winds from a southerly direction for the past 2 or 3 weeks and that according to the inhabitants (one small family of Eskimos), the adult mosquitoes had emerged within the past 10 days. Therefore, we were able to gather a relatively large sampling of mosquitoes with a feeling that they belonged to the immediate area and had not been carried a considerable distance by the winds, as can sometimes happen in the tundra regions of the far north. Three days after arrival at the mouth of the Colville River, strong southerly winds were encountered that lasted for 48 hours. After the wind subsided, the feeding rate of the mosquitoes was nearly doubled. Prior to the southerly winds, we only found two species of mosquitoes, *Aedes impiger* and *Aedes nigripes.* After the winds, we had four species, thus giving us almost a full complement of arctic mosquitoes again. This would seem to indicate that the mosquitoes had been blown from the south for a considerable distance. Our studies indicated that the tundra mosquitoes were able to tolerate winds more than double that known for the taiga mosquitoes. They were found to bite on the leeward side of one's anatomy in a wind up to 12 miles an hour. We also found that feeding took place at 42° F, although the feeding rate was much lower than when a higher temperature from 55° to 65° F was encountered. The latter temperature was the highest one while we were at the mouth of the Colville River.

Within the tundra, I think that the caribou furnished a considerable source of protein for the mosquito. I have talked with Dr. W. O. Pruitt, and he has indicated that for some days after a large caribou herd has passed through the tundra, one is not bothered by mosquitoes. I have one or two observations from our trip along the Colville River that led me to believe that the mosquitoes do feed extensively upon the caribou. We saw one bull, with his horns still in soft velvet, that had fallen into a small canyon along the river and apparently was unable to climb out. We approached him closely and, with the aid of field glasses, noted that his horns were completely covered with mosquitoes in various stages of engorgement. The caribou calf, with its very short coat, would be particularly vulnerable to the mosquitoes. Natvig (1948) describes very graphically the way in which mosquitoes seek the reindeer in the Scandinavian Arctic. Where the caribou occur in large numbers, I feel that mosquitoes have no problem in securing the single blood meal which they seek in the Arctic. The migratory habits of the caribou also would aid in providing a source of food for the adult mosquitoes within a very broad range.

Many entomologists have speculated about how such huge populations of mosquitoes can occur year after year in the northern regions, thinking that it would be impossible for all of them to obtain a blood meal. Hocking (1952, 1954) reported that *Aedes communis* did not attempt to seek a blood meal, but that an histolysis of the flight muscles occurred, furnishing enough energy for the female to deposit a small number of eggs. My own data in several regions of Alaska do not support these concepts of Hocking's. In fact, in certain areas (for example, Anaktuvuk Pass) *Aedes communis* was one of the most abundant blood seekers. In fairness to Hocking, I must admit that in other areas I had found this mosquito quite reluctant to feed when other species were willing to bite with considerable vigor. In most respects my concepts agree with Beckel (1954). Indeed, with so little knowledge of the adult mosquitoes feeding habits and the fact that what is known now appears to be conflicting, this problem must be approached from several aspects.

Hocking *et al.* (1950) reported that feeding on nectar was a "universal habit" among the female mosquitoes at Fort Churchill, Manitoba, Canada. They found that at least 74% of the mosquitoes attracted to man in the middle of July in 1948 had fed on the common woods orchid, *Haberaria obtusata.* These investigators observed that as the season progressed, the majority of mosquitoes attracted to man carried eggs in various stages of development, and they doubted that many of them could have had a blood meal.

It is an established fact that some mosquitoes can lay viable eggs without having a blood meal, as one can readily ascertain from the numerous reports in the literature of such famous mosquitoes as *Aedes aegypti.* One of the first notable experiments along this line was that of Trembley (1947), in which she raised 26 generations of *Aedes triseriatus* in the laboratory without a blood meal. Going back to Hocking's (*ibid*) concepts, he indicated that with the autolysis of flight muscles in *Aedes communis,* there was a concurrent increase in ovarian development. According to Hocking's evidence, the average number of eggs produced by such a mosquito was 65 and the maximum was 93. He could find no evidence of blood feeding in this form of *Aedes communis.* On the other hand, Beckel (1954) working in this same area (Fort Churchill) found no autolysis in the flight muscles in this or any other species he studied. Beckel also indicated that *Aedes communis* had a large fat body similar to the *Anopheles* mosquitoes in the Mediterranean regions, in which gonotrophic dissociation occurs. Apparently certain strains of *Aedes communis* draw on this fat body for the production of eggs, while other boreal mosquitoes studied simultaneously cannot, even though one is present. As a result of these observations, Beckel believes that the blood meal is still the most probable source of protein for egg development. I think, without question, that the mosquitoes that do have a blood meal will lay a larger number of eggs than those that have depended upon pollen as a source of protein.

Hocking has presented evidence to indicate that flower feeding by northern mosquitoes was considerably greater than had been previously supposed. By inserting a thermistor in the arctic poppy, he was able to show that there was an increase in the temperature of as much as 6° F within the parabola formed by the petals of the flowers. Corbet (1964) has recently shown that *Aedes nigripes* and *Aedes impiger* commonly take nectar especially that of arctic avens, *Dryas intergrifolia,* during their first 24 hours. Corbet further observed that these mosquitoes could lay a batch of eggs when maintained on *Dryas* flowers and/or sucrose. However, this type of autogenous ovarian development caused marked resorption of oocytes such that only one mature egg is laid. Further study of the feeding habits of boreal mosquitoes is needed, but I think the data supplied by Corbet will be most germane.

Phenological Data:—As indicated earlier, weather is of extreme importance in affecting the activity of an adult mosquito, even though these boreal creatures are remarkably well adapted to their rigorous environment. Of the various elements of weather that were studied in this investigation, temperature was found to be the most important during a 24-hour period. Light is of considerable importance at the lower latitudes, nearly all species in that environment being largely crepuscular. However, this is not the case in the boreal region because the habitat is modified by the almost continuous periods of light during the mosquito season.

Tables VI and VII are tabulations of the phenological data and the numbers of mosquitoes collected during two different 24-hour period feeding cycles in Nordale Woods. They were selected at random and in the discussion that follows, will not appear to agree completely with some of my conclusions based on the overall aspects of the data. However, I think it is particularly significant to note that when the temperature was below 50° F the feeding habit was markedly impaired. If the temperature was above 50° F, near 2400 hours, the biting records were as high as anytime during the day. In the two examples shown, this actually was the case; however, more often than not, the temperature at this time (2200–2400 hours) frequently dropped below 50° F with a subsequent drop in biting records.

TABLE VI. Twenty-four Hour Biting Study Taken in Nordale Woods 22 June 1961. At this time, the "black-legged" *Aedes* prevailed.

Time	Temp.	Relative Humidity	Foot Candles	No. Mosquitoes
0200	54	82%	36	77
0400	52	82%	95	65
0600	53	82%	175	40
0800	60	73%	750	87
1000	57	61%	110	63
1200	71	48%	300	73
1400	70	40%	300	117
1600	67	48%	450	90
1800	67	45%	450	91
2000	55	64%	57	93
2200	59	72%	10	123
2400	55	79%	2	129

Figure 9 shows a composite of the 24-hour biting records taken at Nordale Woods during the summers of 1960 and 1961. This is based on collections starting at 0200 hours and taken every two hours, the last collection being made at 2400 hours. At first glance, the data seem to support Gjullin *et al.* (1961) who indicates that the greatest activity tends to coincide with what would ordinarily be the twilight period. However, the collection data show that on those days when the temperature remained relatively constant, little or no difference could be seen in the biting records, even though the light reading varied from 1000 foot candles to 1. In other words, with even the darkest period of the day, if an adequate temperature was maintained, the feeding activity would be as great as during the so-called "crepuscular period."

TABLE VII. Twenty-four Hour Biting Study Taken in Nordale Woods 6 July 1961. The "banded-legged" *Aedes* were the dominant forms.

Time	Temp.	Relative Humidity	Foot Candles	No. Mosquitoes
0200	45	86%	12	4
0400	43	85%	90	1
0600	50	80%	180	12
0800	55	65%	820	22
1000	62	45%	240	25
1200	70	36%	850	14
1400	71	33%	350	31
1600	71	37%	500	15
1800	69	43%	250	35
2000	63	50%	85	24
2200	57	77%	16	38
2400	53	73%	1	37

Our studies at Nordale Woods indicated that mosquito activity was almost nonexistent below 46° F and ceased above 80° F, with the possible exception of *Aedes excrucians* which appears to be better than any other Alaskan mosquito. The optimum temperature appeared to be approximately 65° F. At the mouth of the Colville River the mosquitoes showed considerable activity at 42° F but were not particularly active when the temperature exceeded 65° F.

Mosquitoes in the taiga will almost cease activity when the wind speeds are above 5 miles per hour; they are noticeably influenced at a rate of 3 miles per hour. However, in the tundra the mosquitoes are not affected by a rate of 5 miles per hour, and I have noticed little difference in their feeding habits until the wind approached approximately 8 miles per hour, when a rather sharp drop was encountered. However, a reasonable number continued to bite up to and including wind velocity of 12 miles per hour.

With relation to the relative humidity, we were unable (as were Gjullin *et al.,* (1961), and Pratt, (1949), to show any clear correlation between relative humidity and the mosquito activity. In working on Canadian species of *Aedes* in the field, Brown (1951) observed that when the temperature was about 15° C (59° F) moisture was the chief attrahent factor. Hocking *et al.* (1950) converted their humidity data to saturation deficiency values and were then able to demonstrate a correlation with feeding activity. I have been able to compile only a small part of my humidity data on this basis, and thus I will have to accept the values reported by Hocking. He felt the effect was somewhat delayed, with the peak figures rising shortly after a fall in saturation deficiency and falling shortly after a rise. On the other hand, Platt *et al.* (1958) concluded that they had shown at 100% positive correlation (in nature) between relative humidity and the abundance of *Aedes vexans* throughout the night, regardless of elevation, time of night or habitat (woods or open field). According to these authors, the optimum humidity for most of their study period was 70%; the range was 60–90%. Inasmuch as Platt *et al.* did this work in Georgia, the temperature factor apparently did not exert as strong an influence as it does in the subarctic, where almost each night there are a few hours when the temperature is low enough to curtail the activity of the mosquitoes (even though the relative humidity simultaneously reaches its highest peak at this time).

Data presented indicate that temperature is the most important single factor in the absence of wind. The latter factor can actually overpower all others if of a high enough velocity. Relative humidity, without doubt, has much to do with the longevity of mosquitoes in the long run, but for short periods of time, such as when seeking a host, they are apparently able to tolerate a wide range. Sunlight is not thought to be as important as the aforementioned factors, but additional studies may shed more light on this confusing problem. One or two species, such as *Aedes excrucians* are active during the brightest part of the day yet even the peak activity of this species is greater during the duller portions of the day.

Insofar as the inversion of temperature factors is concerned, various authors, among them Gjullin *et al.* (1961), have discussed the importance of this in the feeding activity of the mosquitoes and have termed it "lapse rate." According to them, when an extreme inversion condition was present (as for example, when the temperature at 5 feet above the ground was below 45° F and the warmer temperatures were above head level) no mosquitoes were found at body level, but they were seen flying in the warmer air overhead. I do not know what to make of their data, but I do know that in our study of vertical distribution at Nordale Woods, we had some excellent temperature inversions and still the numbers of mosquitoes encountered in the bait boxes at the upper levels were considerably lower than those on the descending levels. It may well be that our problem here lies in the fact that when this occurred, the temperature at 3 feet above ground was not below 45° F.

SUMMARY: A feeding period of 15 minutes was utilized to gain information on the feeding habits of Alaskan mosquitoes in correlation with phenological data. An area of 54 square inches was used on the forearm of man and the white laboratory rabbit. Most of the results were obtained in the taiga, although studies were made along the Colville River from Umiat to the Arctic Ocean in 1962.

From the data gathered, temperature, wind, light, and relative humidity were of importance in the order listed. The importance of light is not well understood but further studies should resolve much that is now questionable.

Studies concerned with host-seeking and vertical stratification indicated that the majority of mosquitoes did not go beyond 18 feet from the ground when attempting to feed. Hares and rabbits were preferred to gallinaceous birds. Man appeared to be a more favorable host than any of the animals tested, although little is known concerning the large herbivores such as moose and caribou. Mosquitoes are known to feed upon them but observations were not made on the species complex.

Of approximately 24 species of mosquitoes in the taiga, 7 are of major importance. They are *Aedes intrudens, Aedes punctor, Aedes communis, Aedes hexodontus, Aedes excrucians, Aedes stimulans,* and *Aedes pionips.* One of the vagaries of Alaskan mosquitoes is illustrated by the fact that Craig (1955) found *Aedes canadensis* in different locations. It has not been taken since, in spite of special efforts to secure it.

The voles such as *Clethrionomys* and *Microtus* are not thought to be important hosts for mosquitoes. Evidence thus far obtained does not indicate that passerine birds are important, especially the nestlings, even when living close to the ground. Observations were not made with regards to the aquatic or shore birds except on an occasional basis. Mosquitoes were observed hovering around nesting mallards on at least three occasions, however, no attempt was made to secure specimens from these hosts.

Data were not consistent, but on the basis of field observations and those in the laboratory (to be reported elsewhere) it appears probable that Alaskan mosquitoes generally do not seek more than one blood meal and ordinarily do not oviposit more than once. The importance of pollen feeding needs further study before its role in the maintenance of mosquito populations is clearly understood.

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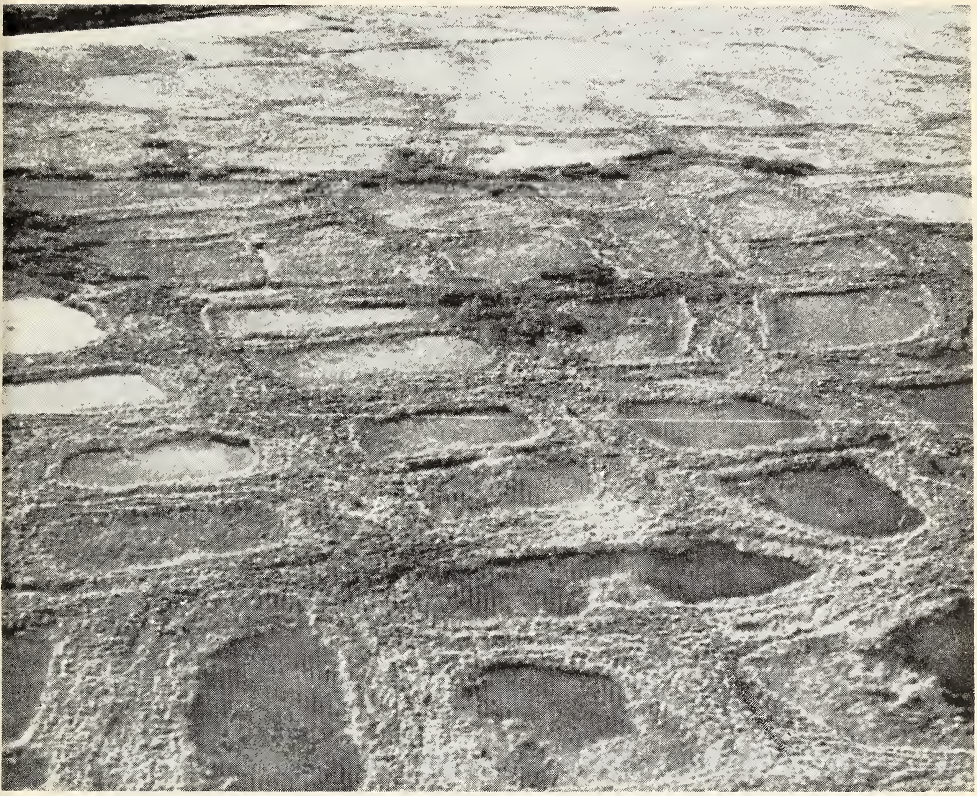


Fig. 1.—Polygons characteristic of parts of the tundra on the Arctic Slope. Permafrost lies only a few inches below the surface of the ground in the summer. As the snow melts in the spring, the frozen ground retains the water at the surface, thereby providing breeding places for the "tundra" mosquitoes. The mosquito season north of the Brooks Range lasts approximately one month, but while it lasts, it is probably the most intense one in the world. Photo by F. White.

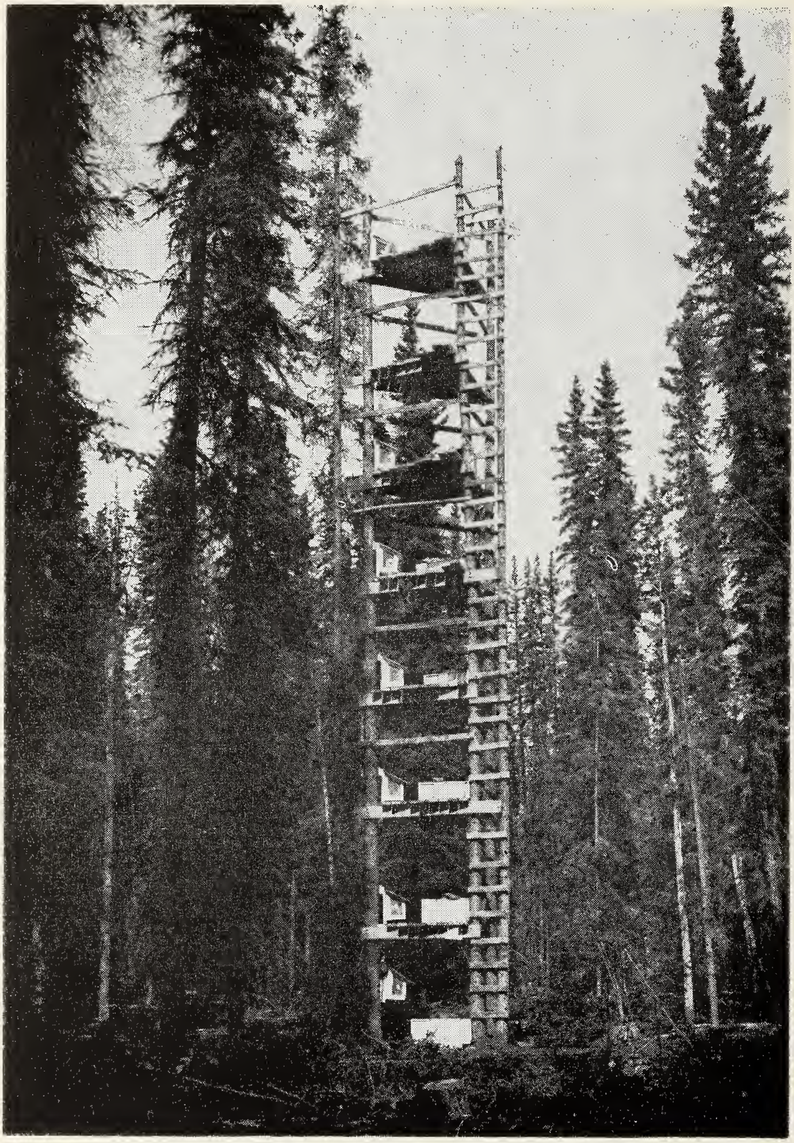


Fig. 2.—Tower constructed in Nordale Woods to study the vertical distribution of mosquitoes in a forested area. Weather boxes with hygrothermographs and "bait boxes" used in studying host attraction of subarctic mosquitoes were placed on the ground and at each level. Highest level was 42 feet above the ground.

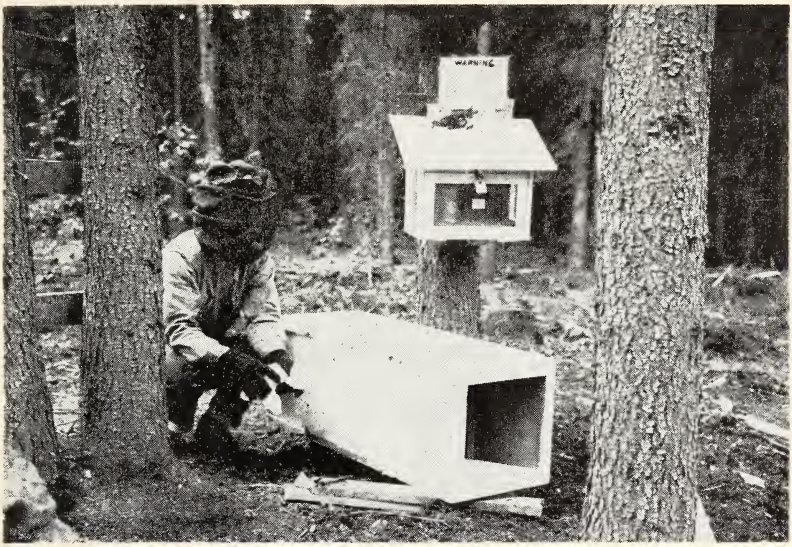


Fig. 3.—Weather box and bait box at ground level of the tower shown in Fig. 2. The weather box housed a hygrothermograph.

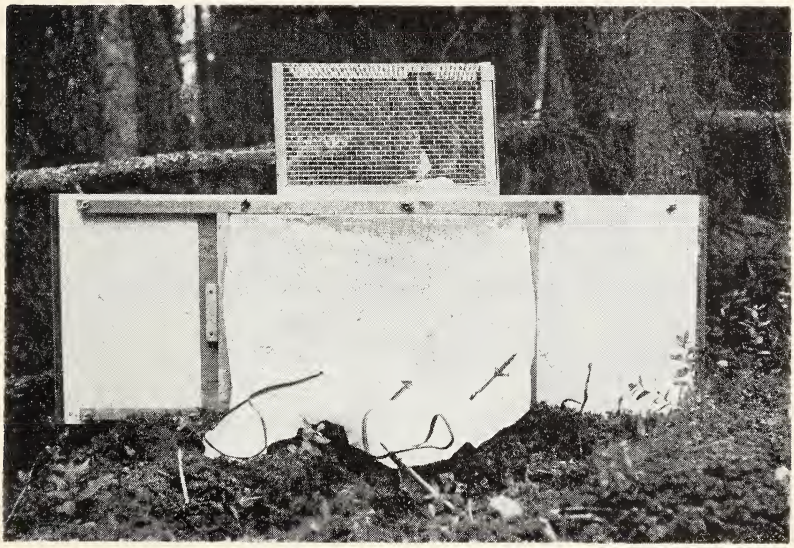


Fig. 4.—Bait box showing the enclosure used to contain a varying hare.

Fig. 5 has been omitted.

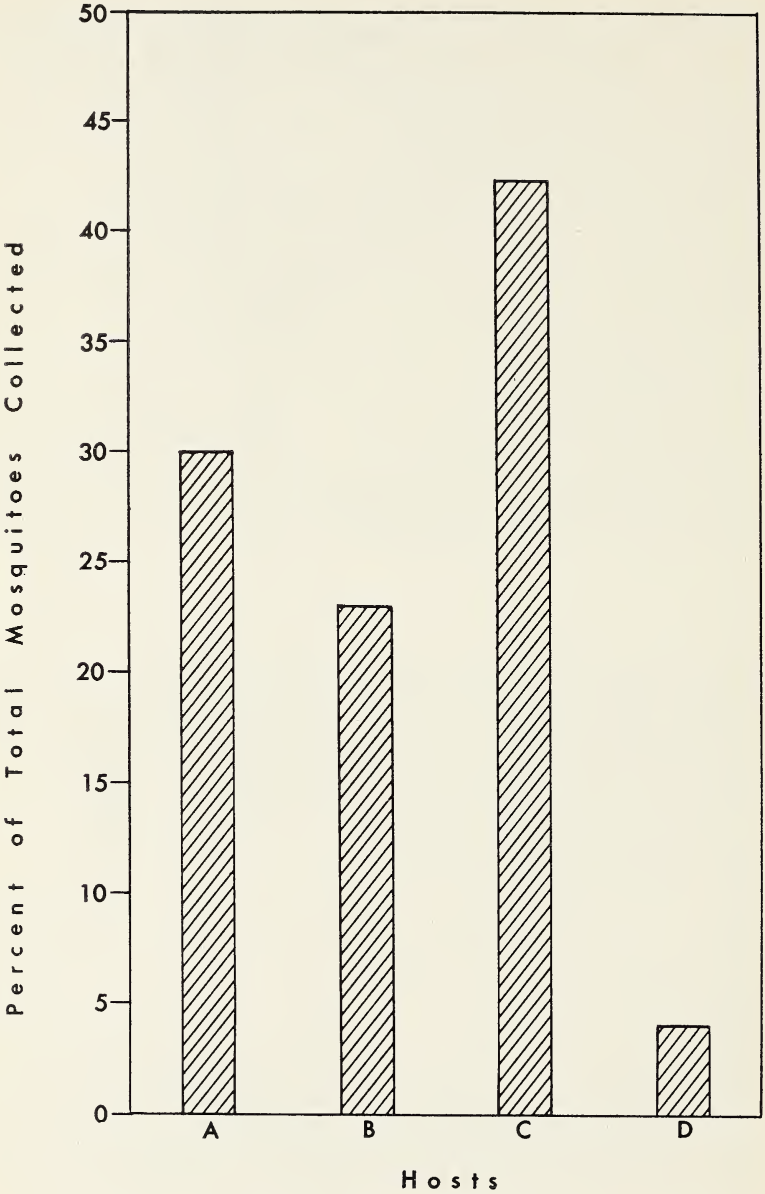


Fig. 6.—Percentage of mosquitoes attracted to each host in the study of vertical distribution of the mosquito. Data for this figure were taken from the preceding table. A. white rabbit, B. domestic chicken, C. varying hare, D. control (empty bait box).

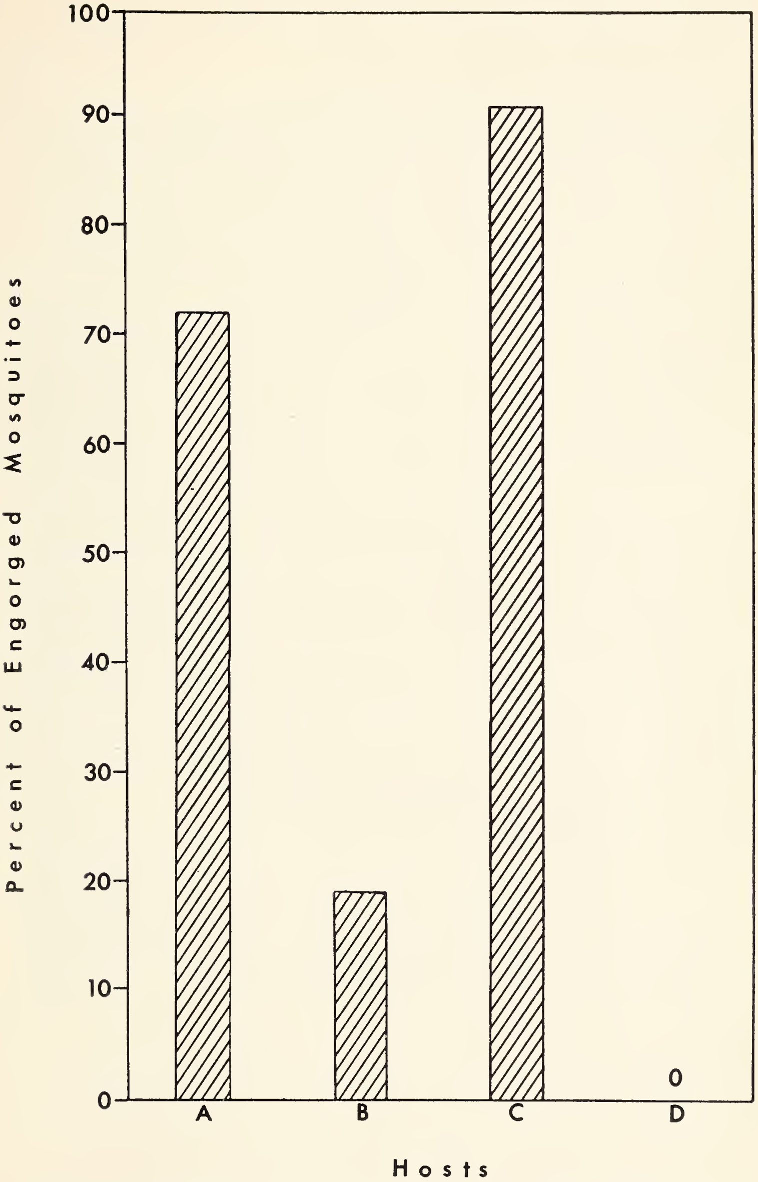


Fig. 7.—Percentage of captured mosquitoes that were found engorged in the bait boxes with the various hosts. Although the domestic chicken attracted a reasonable number of mosquitoes into the box, very few sought a blood meal. A. white rabbit, B. domestic chicken, C. varying hare, D. control (empty bait box).

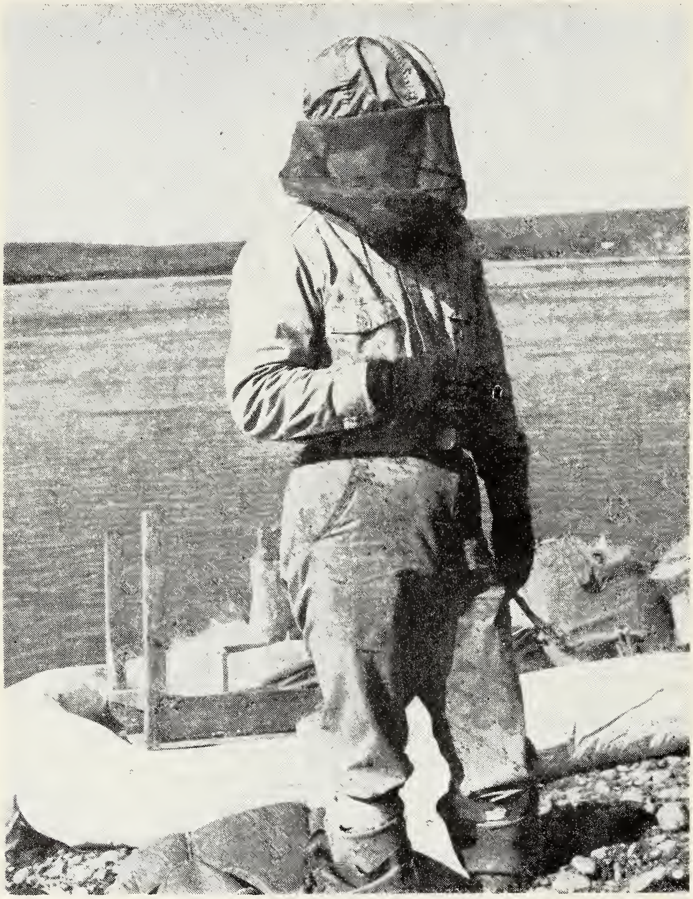
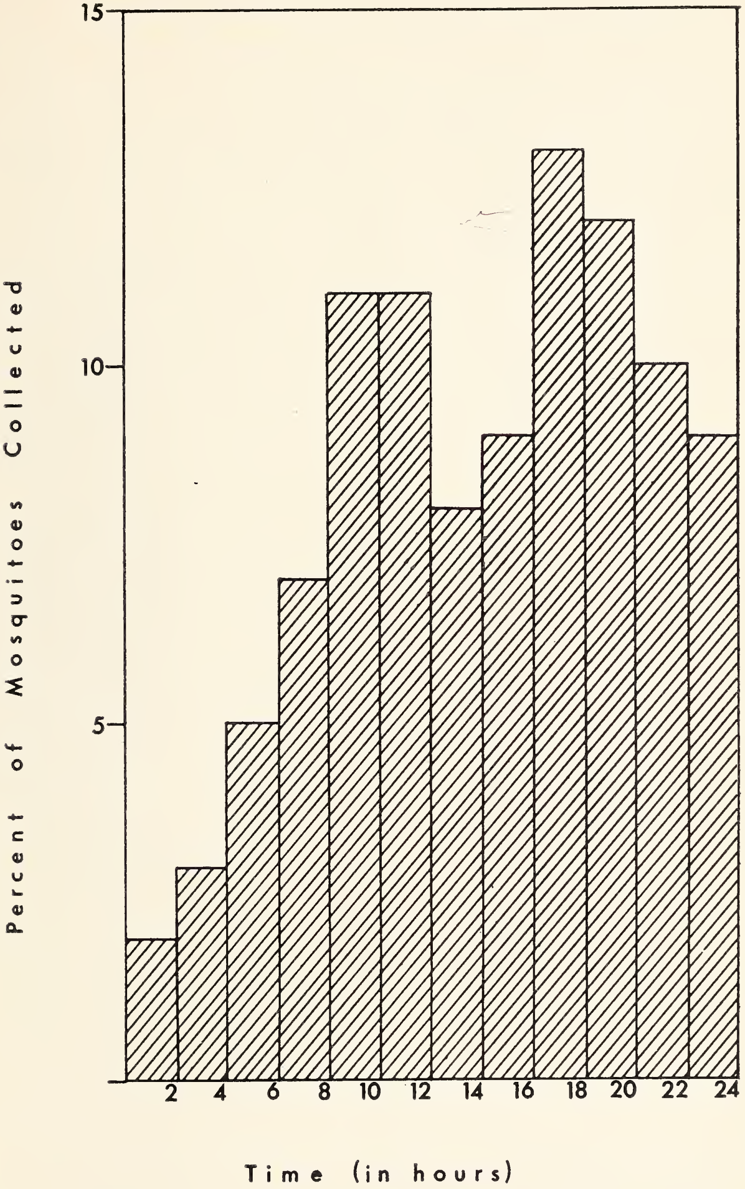


Fig. 8.—Mosquitoes swarming around the author at the mouth of the Anaktuvuk River.



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